TECHNICAL MANUAL

QUALITY CONTROL OF FUELS AND LUBRICANTS

(ATOS)

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INTRODUCTION

1. PURPOSE.

This technical order prescribes the procedures for assuring the quality of fuels and lubricants used by Air Force activities. It applies both to overseas areas and to the Continental United States (CONUS).

2. SCOPE.

Procedures and instructions prescribed by this publication apply to receiving, storing, handling, testing, and dispensing of fuels and lubricants at Air Force installations. At Air Force assigned intermediate depots, where the Air Force has Quality Surveillance (QS) responsibilities, the quality procedures outlined in MIL-STD-3004 and this technical order apply. Where content of this technical order may conflict with fuel quality instructions or procedures contained in other government documents or publications, the provisions of this technical order take precedence. These instructions will be used in conjunction with MIL-STD-3004 and Air Force Occupational Safety and Health (AFOSH) Standards, wherever applicable. The provisions of this manual are compatible with NATO Standardization Agreement (STANAG) 3149, 1135, ASCC AIR Standards 15/1 and 15/3D. This technical order is the established quality control program as required by DoD 4140.25M.

SAFETY SUMMARY

1. The following are general safety precautions and instructions that people must understand and apply during many phases of operations in fuel handling and laboratory operations to ensure personal safety and health and the protection of Air Force Property.

2. WARNING AND CAUTION STATEMENTS.

WARNING and CAUTION statements have been strategically placed throughout this text prior to operating or maintenance procedures, practices, or conditions considered essential to the protection of personnel (WARNING) or equipment and property (CAUTION). WARNINGs and CAUTIONs will apply each time the related step is repeated. Prior to starting any task, the WARNINGs or CAUTIONs included in the text for the task will be reviewed. Compliance is mandatory prior to performing the next step in the task. Consult the local Bio-Environmental Engineer for specific protective equipment and ventilation requirements.

3. GIVE CLEANERS/CHEMICALS SPECIAL CARE.

Keep cleaners/chemicals in approved safety containers and in minimum quantities. Some cleaners/chemicals may have an adverse effect on skin, eyes, and respiratory tract. Observe manufacturer's WARNING labels; Material Safety Data Sheet (MSDS) instructions for proper handling, storage, and disposal; and current safety directives. Use cleaners/chemicals only in authorized areas. Discard soiled cloths into safety cans. Unless otherwise indicated in the text, use as described in this T.O. should not result in any immediate health concerns. Consult the local Bio-Environmental Engineer and Safety Office for specific protective equipment and ventilation requirements.

4. PERSONAL PROTECTIVE EQUIPMENT (PPE).

Wear protective clothing/equipment (gloves, apron, eye protection, etc.) approved for the materials and tools being used. Contact supervisor for guidance. If necessary, the Bio-Environmental Engineer or the Base Safety Office should be contacted for guidance.

5. CHEMICAL DISPOSITION.

For proper disposition of chemicals cited for use in this technical order, review applicable MSDS and consult with local Environmental Management and Bio-Environmental Engineering Offices for guidance.

6. DEFINITIONS.

WARNING

Highlights operating procedures or practices which, if not correctly followed, could result in personnel injury or loss of life.

CAUTION

Highlights operating procedures or practices which, if not strictly observed, could result in damage to or destruction of equipment and/or property.

NOTE

An essential operating or maintenance procedure, condition, or statement, which must be highlighted.

Shall and Will	Indicate mandatory requirements. Will is also used to express a declaration of purpose.
Should	Indicates a preferred method of accomplishment.
May	Indicates an acceptable, optional, or suggested means of accomplishment.

CHAPTER 1
GENERAL

1.1 GENERAL SAFETY AND ENVIRONMENT CONSIDERATIONS.

Petroleum products are hazardous due to their toxic, explosive, flammable, and environment damaging natures. Prescribed safety precautions will be strictly followed for the safety and protection of personnel, equipment, and the environment. Fire hazards are present wherever petroleum products are handled due to leaks, spills, vapor accumulation, improper grounding/bonding of equipment, or ignition from a heat source. Leaks or spills must be eliminated to prevent pollution of waterways and underground water tables. CFR Title 40, Part 112.7, GUIDELINES FOR THE PREPARATION AND IMPLEMENTATION OF A SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN provides guidance on establishing an adequate spill prevention control program. All spills will be promptly reported to the applicable agencies (Fire Department, Safety Office, Bio-Environmental Representative, etc.). Air Force Instruction (AFI) 23-201 and Air Force Occupational Safety and Health (AFOSH) Standard 91-38 outline general safety guidelines to be followed. T.O. 42B-1-23, titled MANAGEMENT OF RECOVERABLE AND WASTE LIQUID PETROLEUM PRODUCTS provides guidance in the collection, segregation, and disposition of recoverable and waste liquid petroleum products.

1.2 TEMPERATURE CONTROL.

Maintain Base Fuels Laboratories at a temperature of 73° ± 5°F (23° ± 2°C). Large temperature fluctuations adversely affect laboratory equipment and fuel samples. This could cause inaccurate analysis of fuel properties and allow issue of contaminated fuel to aircraft.

NOTE

Hot water used for cleaning laboratory glassware will be a minimum of 130°F (54°C) at the tap.

1.3 RESPONSIBILITIES FOR FUEL QUALITY.

Military petroleum products require quality surveillance from the point of initial acceptance by the government until they are actually used. Every agency in the supply system that transports, stores, distributes, or issues these products is responsible for some phase of quality control. Every individual who physically handles petroleum products shares this responsibility.

1.4 QUALITY ASSURANCE AT ORIGIN.

Quality Assurance Representatives (QAR) and Quality Surveillance Representatives (QSR) of the Defense Energy Support Center (DESC), monitor fuel and lubricant quality through surveillance of supplier's production, storage, testing, loading, and shipping procedures. Quality assurance of petroleum products at procurement and quality surveillance of USG-owned petroleum products is the responsibility of DESC or the military service owning or operating the terminal. The authorized Government Representative whose name appears on the shipping document must be contacted when irregularities arise with receipts of fuels or lubricants.

1.5 QUALITY SURVEILLANCE AT BASE LEVEL.

a. Fuels Management (FM) is responsible for the quality of all Defense Working Capitol Fund (DWCF) fuel through the point of sale. The FM also provides advice and analysis on products issued from DWCF stocks.

b. Submit reports of product not meeting specification requirements or receipt limits to DET 3, WR-ALC/AFTH with info copies to the MAJCOM and HQ USAF/ILGM. DET 3, WR-ALC/AFTH will evaluate and determine if further assistance/action is required by DESC-BQ. The report shall be in writing using the SF 368 or any other type correspondence (facsimile, e-mail, or message) using the SF 368 format. As a minimum, the report will contain the following information:

- Specification and Grade
- Quantity
- Location
- Date of Receipt
- Name of Manufacturer/Shipper, Contract Number, Batch Number, Qualification Number, Date of Manufacturer/Shipment, Transportation Mode, and Company, etc., as applicable
- Type of Container or Storage
- Accountable Military/Civilian Department
- Need for Replacement Product

- Detailed Laboratory Test Results Including, if known, Degree of Contamination and Contaminated Materials – test results reported shall include all known characteristics, whether on-specification or off-specification, and appropriate Type A or B test results performed on stock just prior to identification of contamination problem.

- Recommended Alternate Use, Disposition, or Proposed Recovery Measures, if appropriate

c. Specification and receipt limits for each turbine fuel type are shown in Table 5-2. Specification limits apply only to product received direct from a refinery. Receipt limits apply to government owned product transfers from a military service or from a Defense Fuel Support Point (DFSP). When product is received or contaminated on-base beyond the limits specified in this technical order, obtain dis position instructions from the DET 3, WR-ALC/AFTH, DSN: 785-8070.

d. The Logistics Readiness Squadron Commander is responsible for quality surveillance of packaged petroleum products including aviation oils maintained in the base FP stock record account (Table 8-1 and Table 8-2).

e. Aircraft Maintenance Organizations are responsible for quality surveillance of packaged products in their possession. Quality procedures are contained in Chapter 8 of this publication.

f. Quality surveillance of petroleum/gasohol products in organizational support tanks is the responsibility of the tank custodian.

1.6 DET 3, WR-ALC/AFT TECHNICAL DIVISION.

DET 3, WR-ALC/AFT Technical Division provides technical support for fuels and lubricants quality surveillance as follows:

a. Maintains and operates Aerospace Fuels Laboratories which provide testing services for AF bases and establishes requirements for the services of various commercial laboratories to perform specification testing on an emergency basis at specified locations. Table 4-1 shows the geographical area of responsibility for each Continental United States (CONUS) and overseas area laboratory.

b. The POL Technical Assistance Team is available to assist FM personnel worldwide in identifying and correcting quality problems. The Technical Assistance Team can be reached at DSN: 785-8070. Requests for assistance will be coordinated with the MAJCOM.

c. Provides technical guidance on facilities, equipment, and training of personnel with respect to handling or testing petroleum products.

1.7 LIST OF FORMS.

a. DD Form 250 Series Forms are Used for Record Control of Fuel Shipments

b. AF Form 979, Danger (Tags)

c. AF Form 980, Caution TAG

d. AFTO Form 148, JP-8+100 Acknowledgment

e. AFTO Form 149, Fuel Inoculation Record

f. AFTO Form 422, Fuel Filter Pressure Differential Log

g. AFTO Form 475, Fuels and Lubricant Sample Tag

CHAPTER 2
AVIATION FUELS

2.1 TURBINE FUELS.

Turbine fuels are mixtures of hydrocarbons, broadly classified as kerosene or naphtha based. JP-8, which is now the standard turbine fuel used by the U.S. Air Force and U.S. Army and to some extent by the U.S. Navy, is a kerosene based fuel similar to commercial Jet A and Jet A-1. JP-5 is a kerosene based fuel used primarily in Navy carrier aircraft because of its higher flash point. JP-4, a wide-cut fuel containing approximately equal portions of naphtha and kerosene, was replaced by JP-8 primarily for safety and environmental considerations. There is no specified color standard for JP-8, JP-5, or JP-4 other than the fuel must be clear and bright. Color can range from water-white to yellow (straw) or pastel green color. Table 2-1 provides information on some key properties of JP-8 and JP-5. T.O. 42B1-1-14, FUELS FOR USAF AIRCRAFT, specifies the approved fuel grades to be used in USAF aircraft.

a. JP-8 (NATO F-34) – this grade is the standard USAF turbine engine fuel. JP-8 is a kerosene type fuel similar to commercial Jet A-1 with the addition of Corrosion Inhibitor/Lubricity Improver (CI/LI), Fuel System Icing Inhibitor (FSII), and Static Dissipator Additive (SDA). It is procured to MIL-DTL-83133.

b. JP-5 (NATO F-44) – this grade is used primarily in Navy carrier aircraft, because of its higher flash point (140°F). It is a kerosene type fuel covered by MIL-DTL-5624. Types of tests required and sampling frequencies for JP-5, when used by the Air Force, will be the same as JP-8. The requirements applicable to JP-5 used by aircraft maintenance activities to purge aircraft fuel systems are contained in T.O. 1-1-3.

c. JP-4 (NATO F-40) – this grade is a wide-cut turbine engine fuel and was the primary jet fuel for the U.S. Air Force and U.S. Army from 1951 – 1993. It was procured to MIL-DTL-5624. JP-4 is a highly flammable fuel containing gasoline and kerosene fractions. It closely resembles commercial Jet B fuel. This grade is maintained by select bases to aid in cold weather starting. Types of tests (excluding flash point) required and sampling frequencies for JP-4, when used by the Air Force, will be the same as JP-8.

NOTE

Since JP-4 is no longer used by the Air Force, except for cold weather starts, this technical order will omit all references to this fuel in the remaining chapters.

d. Russian TS-1 – TS-1 grade fuel is normally supplied at civil airports in Russia, former Soviet Union states, and in some East European countries. Typically, it has a lower flash point than JP-8 however, most TS-1 samples will pass specification requirements for JP-8. The use of TS-1 in systems with vane fuel pumps without a lubricity enhancer additive could result in catastrophic pump failure. Other engine fuel system components may also experience problems due to low fuel lubricity. TS-1 has lower thermal stability than JP-8 and could result in residue deposits and coking. TS-1 conductivity may require the antistatic additive to meet weapons system safety requirement.

e. JP-8+100 (NATO F-37) is a JP-8 grade of fuel that contains an additive consisting of antioxidants, detergent/dispersants, metal deactivators, and solvents. JP-8+100 has been demonstrated to reduce fuel system fouling/coking in jet engine nozzles. This additive is high in surfactants which immediately disarms conventional coalescer elements in filter separators.

f. JP-7 and Thermally Stable Jet Fuel (JPTS) – these grades are used in limited quantities for special applications. MIL-PRF-38219 and MIL-DTL-25524 apply respectively. Quality control procedures for these fuels are contained in T.O. 42B1-1-16.

2.2 AVIATION GASOLINE (AVGAS).

All AVGAS is procured according to American Society for Testing and Materials (ASTM) D 910. Aviation gasoline is a mixture of relatively volatile hydrocarbons with small quantities of additives including tetraethyl lead. Commercial Grade 100 Low Lead (LL), (NATO F-18) is blue in color and has a maximum allowable tetraethyl lead content of 2.0 ml/gal. Commercial Grade 80 is red in color and has a maximum allowable tetraethyl lead content of 0.5 ml/gal.

2.3 FUEL ADDITIVES.

WARNING

Undiluted fuel additives (FSII, SDA, and CI/LI) present increased risk to personnel. FSII is both combustible and toxic. It is harmful if inhaled or absorbed through the skin and causes eye irritation. In laboratory studies, FSII caused birth defects and had adverse effects on pregnancy. Prolonged and repeated exposure also causes damage to male reproductive organs. Before handling undiluted FSII, consult appropriate safety and occupational health authorities.

a. FSII conforming to MIL-I-85470 is added to JP-8 and JP-5. This inhibitor is Diethylene Glycol Monomethyl Ether (DIEGME). An icing inhibitor effectively lowers the freezing point of small quantities of free water in fuel. This prevents the formation of ice in the fuel which can clog filter elements and result in engine stalls. FSII does not lower the freezing point of the fuel, but lowers the freezing point of water present in the fuel. This inhibitor also has properties which restrict bacterial growth in fuel systems. Water removes FSII from fuel; therefore, introduction of water must be avoided to the greatest extent possible and free water must be removed at any point where it can accumulate, including aircraft tanks. A decrease in FSII content in fuel is an indication of the presence of water in a system, requiring immediate investigation and corrective action.

SAFETY PRECAUTIONS

1. Protective butyl rubber gloves will be worn when handling undiluted FSII. Goggles and an air purifying respirator are not required when handling undiluted FSII in an outdoor environment.
2. Skin contact with undiluted FSII shall be avoided, but in the event of skin contact, the FSII shall be removed with soap and water.
3. In the event of eye contact, immediately wash the eye with water.
4. Continue the wash for 15 minutes and seek medical help as soon as possible.
5. When the additive is diluted with jet fuel the health hazards are significantly reduced.

b. Corrosion Inhibitor/Lubricity Improver (CI/LI) conforming to MIL-PRF-25017 is required in JP-8 and JP-5 to prevent corrosion of steel surfaces. CI/LI also provides added lubricity to fuel for more effective operation of aircraft system components, such as fuel pumps and fuel controls. The amount blended into fuel depends upon the type used as outlined in the Quality Products Listing (QPL-25017). The Ball-On-Cylinder Lubricity Evaluator (BOCLE), ASTM D 5001, or the High-Frequency Reciprocating Rig (HFRR), ASTM D 6079, is used to measure the lubricity property of fuel. This property, although not a specification requirement, is monitored from the correlation/aircraft servicing sample submitted every 45 days. If the results of the sample show there is not enough lubricity, then the addition of CI/LI is normally the corrective action.

c. The use of a SDA in fuels enhances safety during handling and flight. Electrostatic relaxation times are decreased by increasing the conductivity of the fuel. Stadis 450 is the only approved conductivity additive used in JP-8 and JP-5 by the Air Force. The Navy does not use SDA in JP-5. However, SDA is added where JP-5 is stored for issue and purging of Air Force tactical aircraft. The receipt and use limits for SDA are 50 – 700 CU when measured at the ambient fuel temperature or 85°F (29°C) whichever is lower. Discontinue CU testing when fuel temperatures are below 32°F (0°C). Conductivity levels increase with an increase in fuel temperature and decrease when the temperature is lowered. APPENDIX A to this technical order contains instructions for blending and inject ing SDA to increase conductivity. The use of SDA does not reduce or eliminate the need to follow grounding/bonding procedures.

d. Other Additives – antioxidants must be added to JP-8 and JP-5 if blend stocks are hydrotreated in the refining process. Antioxidants prevent formation of peroxides which accelerate failure of rubber materials. The addition of metal deactivators by the supplier is optional. Metal deactivators are used to enhance thermal stability of the fuel. Thermal stability is measured by the Jet Fuel Thermal Oxidation Tester (JFTOT) and is a specification requirement. Thermal stability is a very critical property of fuel and is controlled to reduce coking or fuel fouling in engine fuel nozzles, afterburner spray assemblies, and manifolds. The JFTOT test is run every 45 days on the correlation/aircraft servicing sample submitted from each base.

e. Thermal Stability Additive – the Air Force is adding a thermal stability additive to select aircraft. This additive increases the thermal stability from a typical 325°F (163°C) to 425°F (218°C) and is referred to as JP-8+100. This additive is a high

surfactant and is normally injected downstream of fillstand filter separators.

f. The three additives, FSII, CI/LI, and SDA are mandatory in fuels utilized by USAF aircraft during sustained operations. Commercial turbine fuels such as Jet A and Jet A-1 are often issued to USAF aircraft on into-plane contracts without FSII, CI/LI, and SDA during transient operations. However, this should not be misconstrued with the fact that some aircraft are operationally limited on fuels without one or more of these additives. Additive blending procedures are contained in APPENDIX A.

Table 2-1. Turbine Fuel Characteristics

Flash Point	Freeze Point	Vapor Pressure	API Gravity	Typical Weight
JP-8 (100°F) (38°C) Minimum	–53°F (–47°C) Maximum	Negligible	37 – 51	6.7 lb/gal
JP-5 (140°F) (60°C) Minimum	–51°F (–46°C) Maximum	Negligible	36 – 48	6.8 lb/gal

CHAPTER 3
FUEL HANDLING

3.1 SCOPE.

This chapter describes Air Force fuel systems and discusses the relationship of specific system components in maintaining fuel quality. Specific operating guidance is provided in this chapter to ensure product quality. Sources and types of contamination are identified to aid base personnel in preventing quality degradation.

3.2 RESPONSIBILITIES.

a. FM is responsible for the operation of base fuel systems and operator maintenance of these systems.

b. The Base Civil Engineer is responsible for maintenance of fixed systems beyond operator maintenance as Detailed in Unified Facilities Criteria (UFC) 3-460-03.

c. Base Vehicle Maintenance is responsible for the maintenance of mobile refueling equipment beyond the scope of operator maintenance.

d. The DESC funds projects related to maintenance, repair, environmental compliance, and minor construction of DoD owned fuel handling systems.

3.3 STRAINERS.

a. Strainers are metal screens installed at selective points in base receiving and dispensing systems for the removal of large solid contaminants. The most common types are basket strainers and cone strainers. Strainers with various size openings are used as required in T.O. 37A-1-101 and UFC 3-460-03. Mesh size refers to the number of openings per linear inch, i.e., 100-mesh screen has 100 openings per linear inch or 10,000 openings per square inch. An opening this size is equivalent to a particle size of 150 microns.

b. A properly designed and installed strainer directs all flow through the screen. The proper size basket or cone strainer must be installed and the seating surfaces must be sealed to prevent fuel from bypassing. If fuel bypasses the screen or if it is broken, the strainer is useless.

c. Clean and inspect mobile equipment strainers In Accordance With (IAW) T.O. 37A-1-101. Fixed equipment strainers will be cleaned and inspected IAW UFC 3-460-03 and T.O. 37-1-1. Nozzle strainers are not required in fillstand bottom loaders. The amount and types of material found in strainers are indicative of problem areas such as deteriorated hoses, dirty pipelines and tanks, ruptured filter separator elements, etc.

3.4 FILTERS/FILTER SEPARATORS.

a. Where FILTER, FILTER SEPARATOR, and FILTER MONITOR appears in this technical order, the terms are defined as follows:

(1) FILTER, refers to a micronic filter vessel containing 1 or more filter elements. Very few micronic filters are in use, but those remaining consist of treated paper elements or cartridges housed in cylindrical vessels. Filters remove very fine particles from fuel, thus the name micronic filters. Elements are treated to repel water, but will not coalesce water from fuel.

(2) The term FILTER SEPARATOR, is used in reference to a vessel containing 2 stages. The first is a micronic paper filter and fiberglass strand coalescer element. The second stage is a Teflon screen canister or separator element that separates free water from fuel. Both vertical and horizontal types are in use in Air Force systems. The coalescing function is performed as the fuel passes through the first stage or first section of the element assembly. As the fuel passes through the elements, small droplets of water that may be suspended in fuel are coalesced into large droplets. Since the openings of the coalescing elements are very small, removal of fine particles also occurs. Fuel then passes through a water repellent media, such as Teflon coated screen, to prevent coalesced water from being discharged with the fuel. The separated water drops to a sump for removal through an automatic or manual drain valve.

(3) The term FILTER MONITOR is defined as a vessel containing water absorption filter elements that will continually remove dirt and water from aviation fuels down to acceptable levels. Filter monitors can be of vertical or horizontal orientation. As the fuel passes through the elements, the fine particles of dirt and water are removed and stored in the material. As the material removes more contaminates, the DP will increase. Users of filter monitors should not consider these devices to be

fail-safe to shut off the fuel flow if they become saturated with water.

(4) Absorption media elements are used in the filter separators on refuelers handling JP-8+100 fuel. High surfactants disarm coalescer elements allowing water to bypass without being coalesced. Therefore, absorption media elements, which absorb water, are required in refuelers handling JP-8+100. Absorption media elements shall not be used in refuelers issuing JP-8.

WARNING

Exercise caution when draining systems under pressure.

b. Draining vertical and horizontal filter, filter monitor, and filter separator sumps under pressure is necessary to ensure removal of all water and contaminants. Follow the procedures below:

(1) Drain all fixed and mobile filter, filter monitor, and filter separator vessels under pressure daily when used. Inspect the product drained from the sumps for the presence of water or a thick gelatinous fluid.

(2) Drain (under pressure) a minimum of one gallon (continuous, without stopping) from all vertical and horizontal filter, filter monitor, and filter separator sumps (preferably into a bowser, Gammon white bucket, or equivalent); then perform a visual analysis for color, water and solids using a clean, clear quart jar. If the visual analysis fails, continue using the procedures above until a clear and bright sample is obtained. If a brownish gelatinous substance is detected, contact DET 3, WR-ALC/AFTH, DSN 785-8070 for guidance/instructions and increase sumping throughout the fuel system to twice daily/each shift. Typical analysis of the gelatinous substance is approximately 40 – 50% FSII, 40 – 50% water, and 1 – 4% other substances. This substance can migrate through filters, disarm filter elements, and cause corrosion in fueling systems. Keeping free water out of fuel is the best preventive measure for minimizing the formation of this substance. Request LFM/RFM open and inspect filter separator/water absorption vessels to determine if elements require changing. Continue increased sumping until the substance is no longer evident. When draining sumps on vessels containing water absorption filter cartridges, pay close attention for media migration. Normally the media is reddish or reddish brown in color and is a very thick substance. If any substance comes from a vessel containing water absorption cartridges, the vessel shall be opened and inspected accordingly. Changing the elements is the only solution for solving media migration contamination.

c. Replace fixed system filters IAW UFC 3-460-03. Replace mobile equipment elements IAW T.O. 37A-1-101. After elements are placed in service, there should be a gradual increase in differential pressure.

(1) An excessive increase in differential pressure over a short time or after little fuel throughput indicates a system malfunction or product contamination. Determine the cause and take corrective action.

(2) A drop in differential pressure usually indicates a malfunction of the filter separator, such as ruptured elements, unless the reading is taken at lower flow rates.

3.5 TANKS.

Descriptions of tanks for bulk or operating storage service at Air Force installations are given in UFC 3-460-03. The following guidance is limited to those features, practices, and operations directly affecting fuel quality.

a. Do not maintain water bottoms (removable water) in petroleum storage tanks. Active tank water removal systems will be operated daily prior to any product movement. Inactive tank water removal systems will be operated a minimum of weekly. Maintaining a quantity of water in the tank for gauging purposes is prohibited.

b. Gauge barge/tanker compartments for water prior to acceptance and discharge. Pump off excess water prior to acceptance.

c. Operate pipeline receiving tank water removal systems before and after receiving operations.

d. Inspect uncovered floating roof tanks and remove water following heavy rains using the water removal system.

(1) Water removed from tanks, filter separators, water removal systems, low point drains, fuel bowsers, etc., containing an unknown concentration of FSII requires proper handling. Do not drain such products on the ground or into the installation storm drainage system. FSII is a biodegradable hydrocarbon based substance that should present no difficulty in the concentrations present in the water removed from tanks, filter separators, water removal systems, low point drains, fuel bowsers, etc., when drained into the sanitary sewer system. Consult the

Environmental Coordinator to ensure compliance with local, county, state, and federal environmental laws and regulations. The Environmental Coordinator, in coordination with the Base Civil Engineer, will identify sanitary sewer inlets suitable for the disposal of water/FSII concentrations from the sources identified. Alternate procedures will be provided where necessary.

(2) Tanks equipped with water removal systems provide a more efficient means of removing water. After separation of the fuel/water emulsion in the water removal system the free water is drained and then the recovered fuel is transferred back into the tank. All new storage tanks should be programmed for a water removal system that has the ability to re-circulate product through water removal filtration and back through the receipt inlet. Also program new tanks to incorporate a water detection capability in the sump. Report any failure of these systems to operate properly or need for maintenance.

(3) Secure water drawoffs by padlock in the closed position when not in use.

e. The determination of water will be made with Automatic Tank Gauging (ATG) equipment or by gauge and plumb bob using water indicating paste meeting the performance characteristics of MIL-W-83779. However, be advised that water detected by the ATG or plumb bob is cause for concern. The tank may contain an extremely large amount of water as both the ATG and plumb bob normally use the tank datum plate as a reference point that is not at the tank bottom. Two national stock numbers apply for MIL-W-83779, 6850-00-001-4193 (jar) and 6850-00-001-4194 (tube). Water indicating paste will separate during storage or periods of nonuse. Keep water indicating paste well-mixed during use. The jar, NSN 6850-00-001-4193, is recommended in lieu of the tube to enhance mixing. Report quality deficiencies encountered with this product to DET 3, WR-ALC/AFTT, DSN: 785-8050.

3.6 TANK INSPECTIONS AND CLEANING.

Tank inspection and cleaning requirements are stated in T.O. 37-1-1 and UFC 3-460-03.

a. Excessive solids upstream of filter separators or rapid build-up of differential pressure in fixed system filter separators are indications that the tank needs to be inspected and cleaned, if needed.

b. Change of product service from aviation gasoline to jet fuel or vice versa, does not in itself require tank cleaning. In most cases, if the tank was recently cleaned, or determined to be clean by inspection, removal of all product is all that is necessary. However, change of product service from black oil to clean product (aviation fuels) requires chemical cleaning of tank in addition to normal cleaning.

3.7 PRODUCT SETTLING.

a. Aviation fuel received into bulk storage or directly into hydrants must be allowed to settle for a minimum of 8 hours prior to issue or transfer. Observe a longer settling period if mission requirements allow. Prior to issuing or transferring product following the settling period, drain the tank water removal systems and perform a visual test for water and particulates downstream of the issue or transfer filter. In case of emergency, the product may be transferred/issued in less than 8 hours provided the MAJCOM Fuels Division provides concurrence. If operational requirements repeatedly limit settling time to less than 8 hours, confer with the MAJCOM to determine the correct course of action.

(1) Deleted

(2) Deleted

(3) Deleted

b. Operating tanks that receive product from bulk storage (where the product has been allowed to settle for at least 8 hours) does not require a settling period. However, observe a two-hour settling period, or longer, if mission requirements allow.

c. Settling time for ground fuel tanks greater than 84,000 gallons is one hour per foot of fuel in the tank following a receipt. For tanks under 84,000 gallons a settling time of 30 minutes minimum is required. Observe a longer settling period if mission requirements allow.

3.8 CONTAMINATION.

Fuel contamination is generally classified as chemical, biological, or material.

a. Chemical contamination results from mixing 2 different types of hydrocarbon fuels or mixing other chemicals with fuel. Both the chemical and physical properties of fuel are affected. Laboratory testing can usually detect this contamination. Chemical contamination is prevented by isolating different products in separate handling systems, positive physical separation between systems, strict adherence to established operating procedures, and the alertness of operating personnel. Carelessness is the major cause of this type contamination.

b. Biological contamination results from growth of bacteria and/or fungi in water deposits within fuel systems. Growths of these microorganisms have a consistency of SLIME or MAYONNAISE at the interface of fuel and water. This contamination can

plug aircraft filters, cause quantity probe malfunctions, and corrode integral fuel tanks. While fuel system icing inhibitor acts as a biostat, microbial contamination is most effectively controlled by keeping water out of the fuel system.

c. Material contamination consists of water, sediment, and other materials described herein. Precautions must be taken to prevent introduction and subsequent issue of material contaminants particularly whenever repairs are made to fuel system components. Remove particles, shavings, welding rods, mud packs, and other debris introduced during repairs to systems.

3.9 WATER.

Water is present to some extent in all fuel systems. It can enter tanks during product receipt, especially from tankers and barges. It may enter through leaks in underground storage tanks. It may also be introduced as vapor which condenses within the system. Both fresh and salt water can be present as dissolved, entrained, or free water.

a. Dissolved water is in solution with fuel and is always present to some extent. The amount of dissolved water that can be in fuel depends upon the temperature of the fuel and its chemical composition. The aromatic compounds in fuels are chiefly responsible for the amount of water a fuel can dissolve. The quantity of dissolved water in fuel is small and is measured in parts per million. For example, turbine fuel with 10% aromatics at 50°F (10°C) can retain about 54 parts per million of water in solution. Dissolved water cannot be removed by equipment in the fuel handling system. It can precipitate or drop out as free water when the fuel cools. FSII is added to turbine fuels to prevent freezing of these small amounts of free water.

b. Entrained water is free water in suspension in fuel as extremely small droplets. Small amounts are not usually visible to the naked eye, but larger amounts create a milky haze or cloud in fuel. Water can become entrained in fuel by condensation of atmospheric moisture in the vapor/air mixture in a tank when the ambient temperature drops. Free water can be emulsified with fuel by mechanical action such as passing through pumps. Most entrained water will settle out of fuel provided there are not excessive surfactant contaminants present, which will hold water in suspension. Entrained water is removed by the coalescing action of filter separators or by absorption when passing through water absorption cartridges.

c. Free water is not dissolved in the fuel. The term FREE WATER, is usually used to indicate water which settled out of fuel or which coalesced into large droplets for removal from the system.

3.10 SOLID CONTAMINANTS.

a. Sediment appears as dust, powder, grains, flakes, and stains. Sources of sediment are storage tanks, metal vessels, filter or filter separator elements, valves, pumps, meters, pipelines, hose gaskets, diaphragms, and seals. Rust is the most common solid contaminant. Extremely small particles, measured by the micron scale, can cause damage. Fine particles are difficult to detect without the sampling and testing prescribed by this publication. Particles 150 microns and larger are removed by 100-mesh or finer strainers, whereas the majority of smaller particles are removed by filters and filter separators.

b. Valve lubricants can become contaminants, especially if valves are overlubricated. If the plug is adjusted correctly and the valve lubrication system is filled, lubricated plug valves should be lubricated only once a week. This should consist of a few turns of the lubricant applicator screw or a few strokes of a lubricant gun. When valves are not used frequently, they should be lubricated only when opening or closing the valve. Lubricants containing graphite or molybdenum disulfide will not be used in fuel system valves. When replacement of lubricated valves is necessary, only nonlubricated valves will be used IAW UFC 3-460-03. Valves used in sampling lines will not contain a stem packing material such as graphite.

3.11 LINE DISPLACEMENT.

Aviation fuel in the base pipeline system from bulk storage to operating storage or truck fillstands will be displaced at least every 30 days. This will preclude deterioration of some of the properties of fuels such as thermal stability or gum content and protect the line against corrosion. Quality control procedures and sampling frequencies for hydrant systems and shelters are outlined in Table 5-1.

3.12 IDENTIFICATION AND MARKING OF FUEL HANDLING SYSTEMS.

Clearly identify each petroleum piping system by the use of standard markings as prescribed in MIL-STD-161. A yellow arrow in the line adjacent to the painted bands and title markings will indicate the direction of flow of product in the line. Clearly identify each mobile refueling unit and hose cart with the grade of fuel as specified by T.O. 35-1-3 and T.O. 36-1-191.

NOTE

All fuel vehicles, bowsers, drums, and containers used for the segregation and collection of Recoverable and Waste (R&W) products will be isolated, marked, and controlled to avoid commingling of products and issue of off-specification products. Refer to T.O. 42B-1-23 for guidelines on handling R&W products.

3.13 SERVICING CONTROLS.

Servicing controls are required to assure the correct grade of fuel is issued by refuelers. Refuelers must be filled with the right fuel and the correct refueler must be used to dispense the fuel to the aircraft/equipment. T.O. 37-1-1 prescribes specific requirements for servicing controls.

3.14 CONVERTING REFUELING UNITS FROM ONE PRODUCT TO ANOTHER.

a. To convert from JP-5 to JP-8 service or vice versa, the following procedures apply:

(1) Completely empty refueling unit and drain sumps, filter housing, and hoses.

(2) Change unit markings to new grade of fuel and change servicing controls as necessary.

(3) Fill refueler to capacity with desired product and circulate 500 gallons through each hose. Obtain a flow sample and determine flash point. If test fails minimum requirements, repeat steps. If flash point meets 140°F (60°C) minimum for JP-5 or 100°F (38°C) minimum for JP-8, proceed with servicing.

b. To convert JP-8 refuelers to AVGAS, the following procedures apply:

(1) Completely empty refueling unit and drain sumps, filter housing, and hoses.

(2) Change unit markings to new grade and make necessary changes to servicing controls.

(3) Fill unit to capacity with MOGAS. Rotate 500 gallons through the filter separator (flush hoses).

(4) Return the MOGAS to storage half through each hose. Drain filter separator and discharge hoses.

(5) Fill refueler with AVGAS (take a one-gallon sample from receipt vehicle prior to discharge). After receipt of AVGAS, rotate 1,000 gallons through the refueler filter separator and flush discharge hoses.

(6) After rotation, take a sample from the refueler and perform heavy hydrocarbon test IAW Paragraph 5.15. Provided heavy hydrocarbon tests are satisfactory, the refueler is now ready to issue AVGAS.

(7) To convert the refueler back to JP-8, completely empty the unit draining all hoses, the tank, and filter separator sumps. Change unit markings and servicing controls as necessary. Fill refueler with JP-8. Rotate 500 gallons of JP-8 through the refueler filter separator ensuring each discharge hose is flushed with 250 gallons. Place refueler back in JP-8 service.

3.15 SERVICING DRUMMED FUEL TO AIRCRAFT.

Aviation fuel stored in drums can contain water and sediment. Remove these contaminants from the fuel prior to issue to aircraft. Store drums containing aviation fuel or additives on their sides to prevent accumulation of water on the drum ends. Test each drum with water finding paste or draw a sample from the bottom with a drum thief before issue to aircraft. It is sometimes difficult to determine whether the sample is all water or all fuel with undyed products, such as turbine fuel. To determine the contents, place an inch of dyed fuel in the bottle and add the drum sample. If water is present, there will be a separation between the water and dyed fuel mixture. Siphon any water from drums before issue to aircraft.

NOTE

Pass drummed aviation fuel through a filter separator prior to delivery to aircraft.

3.16 DEFUELING AIRCRAFT/BOWSERS.

Aviation fuel mission support refuelers/defuelers will not be used to defuel bowsers, product collection tanks, pits, or to recover reclaimable, recyclable, or waste petroleum products, except as outlined in T.O. 42B-1-23 or in an emergency. MAJCOM Fuels Office must approve emergency limits.

a. Consult with maintenance personnel to determine the fuel grade/additives and assure they drained aircraft sumps. If defueled product is suspected of contamination, other than water or sediment, place the product in a holding tank or retain the product in the defueling unit. Analysis by the area laboratory on quantities less than 1,000 gallons for product recovery purposes is not cost effective. Place the tank or defueling unit on QC hold. For samples representing more than 1,000 gallons, submit a

sample to the area laboratory for testing to determine suitability for use. If laboratory results are satisfactory, return the fuel to the system at the blending ratio specified in Table 3-2. If the fuel is unsuitable for use/blending or is an uneconomical quantity, the product will be disposed of IAW T.O. 42B-1-23.

b. Downgrade and blend JPTS fuel collected in bowsers meeting the test recovery criteria of T.O. 42B-1-23, into the JP-8 inventory. Use the blend ratio in Table 3-2.

c. To enhance quality, return defuels to bulk or operational storage at the blending ratio specified in Table 3-2. Exceptions are:

(1) If defueled product contains dye, an attempt shall be made to return the dyed fuel to the same aircraft.

(2) One time defuels are authorized using in-service refuelers.

(3) Handle defueled product containing JP-8+100 additive by the following priorities:

(a) When defueled by refueler, return the product to another JP-8+100 aircraft.

(b) Return the product to the test cell or AGE tanks.

(c) Return the product to storage tanks at a ratio of 1:100.

3.17 MULTI-PRODUCT PIPELINE SHIPMENTS.

Few multi-product cross-country pipelines are operated by USAF. Refer to MIL-STD-3004 for detailed instructions for the operation of such lines.

3.18 FILTRATION REQUIREMENTS.

Aviation fuel must pass through 2 separate filter separator vessels downstream of bulk storage, with at least 1 filtration downstream of operating tanks. Filtration (coalescer or absorption type) must be provided at the skin of the aircraft. (The exception to this is SERVICING DRUMMED FUEL TO AIRCRAFT outlined in Paragraph 3.15.)

a. Use these requirements when modifying existing systems. See MIL-HDBK-1022 for new system design requirements.

b. The following are the filtration requirements for turbine fuels:

(1) Pipeline receiving facilities shall have commercial or government owned inbound filtration. The filtration capacity shall be capable of handling 150% of the normal pipeline flow rate.

(2) Inlet to Bulk Storage – pass turbine fuels received by barge and tanker through a micronic (prefilter). Install 2 filter separators downstream of the prefilter. Install them in parallel, with each vessel designed to handle 150% of normal off-loading flow rate. Each vessel will have a feature to automatically switch the fuel stream to the other vessel when the differential pressure across the vessel reaches a preset limit. A warning signal will be available to tell the operator that the switching operation occurred. Include the capability to bypass the inlet filter separator bank for emergency use only.

(3) Truck Fillstands – in all cases a filter separator shall be installed between the storage tank and the truck fillstand when the storage tank receives fuel directly from the supplier. When a fillstand is supplied from a tank or tanks that receive fuel from on-base storage, the filter separator downstream of these tanks can be omitted providing all of the following conditions are met:

(a) The tank has an inlet filter separator.

(b) The tank is 100% internally coated.

(c) Slope above or below ground vertical tank bottoms to a center sump (see MIL-HDBK 1022). Slope above or below ground horizontal tanks toward the opposite end of the pump. The slope must be a minimum of 1 inch per 10 feet.

(d) All piping and components downstream of the tank to the truck fill nozzle must be of noncorrosive material.

(e) Piping must not exceed 300 feet between the tank discharge and the truck fill nozzle.

(4) Type I and II Hydrant Systems – pass fuel through 2 filter separators downstream of operating storage before fuel enters the aircraft. The pumphouse filter separator can be omitted provided all of the following conditions are met:

(a) There is an inlet filter separator to the pumphouse operating tanks.

(b) Piping downstream of the inlet filter separator to the tanks is noncorrosive.

(c) Operating tanks are 100% interior coated.

(d) Piping from operating tanks to hydrant outlets is noncorrosive.

(e) The filter meter pit has a filter separator that is set to limit flow at rated capacity of the elements in the filter separator, or the aircraft servicing unit contains a filter separator.

(f) Pass defueled product through 2 filter separators prior to aircraft servicing. The method of accomplishing this requirement must be agreeable to MAJCOM Fuels Engineer and Fuels Management staffs.

(5) Type III, IV, and V Hydrant Systems.

(a) Fuel will pass through 2 fixed system filter separators. One of these filter separators must be located on the inlet side of operating storage and the other filter separator must be downstream of operating storage. Filtration (coalescer or absorption type) must be provided at the skin of the aircraft.

(b) All piping between the inlet filter separator to operating storage and the hydrant outlet must be noncorrosive.

(c) Where fuel is received directly from the supplier (off-base) by pipeline, barge, or tanker to the hydrant system operating tanks, fuel must pass through at least 3 filtrations. The first can be a filter separator or a micronic filter (nominal rating of 10 micrometers or less) located within 1 mile of the base. The first filtration system can be either commercial or government owned. The second must be a filter separator immediately upstream of the operating tank. The third must be a fixed filter separator located downstream of the operating tank. The 3-filtration requirement can also be 2 fixed system filter separators, located on the inlet and outlet of operating tanks and a filter separator on the aircraft servicing unit.

(6) Contamination Monitors – fuel monitors, whether cartridge/fuse type or devices that electronically detect contamination levels in the fuel stream are not required.

3.19 DIFFERENTIAL PRESSURE.

Particulate contaminants in fuel affect the filtering surface of filter separator coalescer elements. During fuel handling operations as the filtering surface collects solid contaminants, there is a corresponding increase in Differential Pressure (DP) across the coalescer elements. An increase in DP is reflected as psi on the DP gauge installed on the instrument panel or vessel.

a. Change coalescer cartridges when the differential pressure reaches the maximum psi level with the filter separator operating at its rated flow. Because systems are often operated at lower flow rates with a corresponding lower differential pressure, it is important to know the pressure differential characteristics at lower rates for a set of coalescer cartridges. If, for example, a 600 gpm filter separator shows a differential of 12 psi at 300 gpm and the flow rate increased to 600 gpm, the differential pressure would be about 24 psi, considerably above the recommended pressure drop for changing elements. Refer to Figure 3-1.

b. There is an exception to the above. In some systems there are filter separator vessels that have a rated flow capacity exceeding the capability of the pump or pumps. For example, a 600 gpm pump delivers fuel through a 1,200 gpm filter separator and the DP limit for this vessel is 20 psi. In this case the 1,200 gpm vessel is considered a 600 gpm vessel since 600 gpm is the maximum flow the vessel will ever see. As a result, the vessel would be permitted to reach 20 psi at 600 gpm before elements require change.

c. It is common practice to operate multiple pumps and filter separators on Type III constant pressure hydrant systems simultaneously to a common discharge manifold. Under these conditions, if only two 600 gpm pumps are operating, the 1,200 gpm flow can be routed through four 600 gpm filter separators. Thus, to accurately determine the DP for each 600 gpm vessel, it will be necessary to isolate each filter separator and manually operate only 1 pump to this filter separator.

d. Base Fuels Laboratory personnel or other qualified personnel designated by FM will observe and record the filter separator differential pressure and flow rate. The frequency is established in Table 5-1 and is the same as sampling downstream of filter separators for solids. The vessel differential pressure and flow rate observed will be recorded on the AFTO Form 422.

(1) The rate of flow on variable flow vessels (i.e., mobile equipment) will be estimated or determined by clocking the meter.

(2) The flow through a filter separator utilized with a constant speed drive and pump (i.e., fixed systems) is regulated by adjustment of the rate of flow control valve. This adjustment is verified by LFM. Use this flow rate for recording purposes.

e. Determine the corrected differential pressure from Figure 3-1 or the table on the back of the AFTO 422 (both of these tables are guides and they reflect approximations). Record the flow rate, observed DP and corrected DP on the AFTO Form 422.

Table 3-1. Conversion Chart for Refueling Units

Last Product Carried	Product to Be Loaded						
	Leaded Gasoline	Nonleaded Gasoline	Turbine Fuel Aviation (Kerosene Type) JP-8	Turbine Fuel Aviation (High Flash Point Kerosene Type) JP-5	Turbine Fuel Aviation JP-7/JPTS	Kerosene	Diesel
Leaded Gasoline	A	C	C	C, D	C, D, E	C	C
Nonleaded Gasoline	A	A	B	B, D	B, D, E	B	B
Turbine Fuel Aviation (Kerosene Type) JP-8	B	B	A	B, D	B, D, E	A	B
Turbine Fuel Aviation (High Flash Point Kerosene Type) JP-5	B	B	A	A, D	B, D, E	A	A
Turbine Fuel Aviation JP-7/JPTS	B	B	A	A, D	B, D, E	A	A
Kerosene	B	B	A	B, D	B, D, E	A	B
Diesel	B	B	B	B, D	B, D, E	A	A

NOTE 1: When draining railcar and tank vehicle particular attention should be given to sumps, pumps, filters, hoses, and other components likely to trap quantities of liquid.

NOTE 2: In all cases, lines, etc., are to be drained to fullest extent practicable and the following action taken:

(A) None, fill with desired product.
(B) Flush with desired product, drain, fill with desired product. (See NOTE 1.)
(C) Inspect for and remove all sludge, in particular traces of lead and gum. Flush with desired product, drain, fill with desired product.
(D) Test for flash point.
(E) JPTS or JP-7 will be loaded only in aluminum, stainless steel equipment, or equipment lined with approved epoxy coating. If cleaned, clean with hot fresh water not exceeding 135°F (57°C) and dry thoroughly.

NOTE 3: This modified table complies with NATO STANAG 3149.

f. The recording of the vessel DP and flow rate by Base Fuels Laboratory personnel does not relieve operators of the responsibility to be familiar with vessel operations, allowable DP at various flow rates, and the need to monitor DP and report any abnormal pressures or flows during operations. Operators may, at the option of FM, record observed and corrected DPs on the AFTO Form 422.

g. The maximum allowable differential pressure across a filter vessel depends on the location of the vessel and the type of elements installed. Filtration vessels in fixed facilities will either meet the maximum DP identified in UFC 3-460-03 or 20 psig at the maximum rated flow of the vessel. Final filtration vessels, i.e., refuelers, hose carts, etc., equipped with coalescing elements have a maximum DP of 15 psig at the maximum rated flow of the vessel. Final filtration vessels equipped with water absorption media cartridges have a maximum DP of 15 psig at the maximum rated flow of the vessel. An exception to this is when a pump or pipe which limits the flow through a filter separator below the rated flow of the vessel. Under such conditions, the maximum allowable DP would be permitted at the maximum flow attainable under the circumstances.

Table 3-2. Turbine Fuel Blending Table

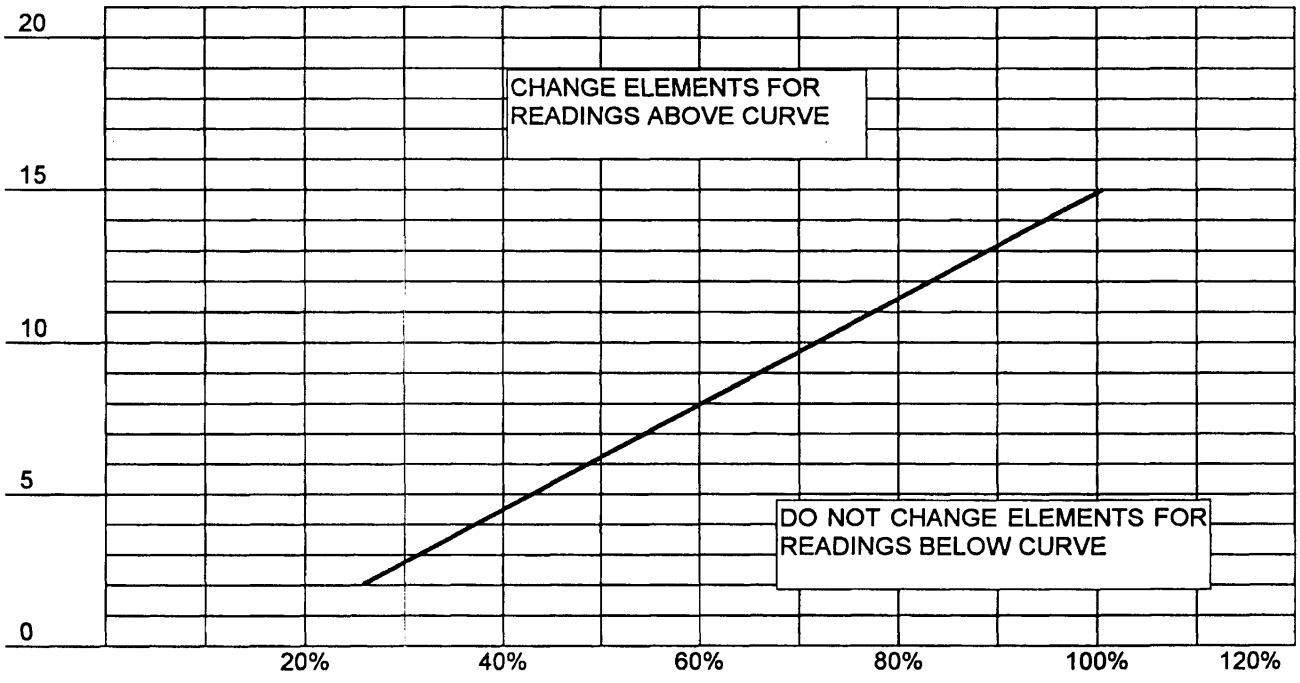
From	Blending Ratio	To
Jet A	One to Four	JP-8
Jet A-1	One to Four	JP-8
JP-4	One to One Hundred	JP-8
JP-5	One to Four	JP-8
JP-7	One to Four	JP-8
JPTS	One to One	JP-8
JP-10	One to Ten	JP-8
Mixed Turbine Fuels	Contact DET 3, WR-ALC/AFTH	JP-8
Diesel Fuel	Contact DET 3, WR-ALC/AFTH	JP-8
MOGAS	Contact DET 3, WR-ALC/AFTH	JP-8
Blend JP-8+100	One to One Hundred	JP-8

EXAMPLE

If downgrading 5,000 gallons of Jet A to JP-8, the 5,000 gallons of Jet A must be blended with at least 20,000 gallons of JP-8.

NOTE

Depending on the type of fuel downgraded and the blending ratios used, it may be necessary to add conductivity additive or FSII to the final blend. Specifications for flash point, cloud point, etc., must be maintained after blend.



EXAMPLE

A 1000 gpm filter separator is operating at 600 gpm (60% of rated flow). If the pressure differential is less than 8 psi, the cartridges do not require changing. If the pressure differential is 8 psi or more, however, the elements are due for changeout.

EXCEPTION

If the system in this example is limited to a maximum flow of 750 gpm by pump capacity or some other factor, then 750 gpm should be considered 100% of rated flow rather than the higher rating of the filter separator. In this case, the 600 gpm flow would be 80% of rated and the differential at this rate can be as high as 11.5 psi without changing elements.

Figure 3-1. Vessel Pressure Drop Characteristics with SPENT Cartridges

CHAPTER 4
SAMPLE SUBMISSION TO OFF-BASE LABORATORIES

4.1 GENERAL.

Sampling procedures greatly influence the validity of test results. The integrity of the sample depends upon the type and cleanliness of the sample container, the sampling procedure, and the sampling purpose. The basic principle of any sampling procedure is to obtain a sample or composite of several samples that is truly representative of the product.

4.2 SAMPLE SUBMISSION.

Submit samples of aviation fuels to off-base laboratories as outlined in this chapter. All samples of aviation fuels will be a minimum of 2 gallons unless otherwise specified. Do not use vermiculite for shipment overpacking, as sample contamination may result. If vermiculite must be used as a packing material, place the sample can in a plastic bag prior to packing in vermiculite.

a. Submit samples to an area laboratory whenever doubt exists as to the quality or identity of petroleum products on the installation. Submit samples of aviation fuel for testing under service contracts only when authorized by the DESC.

b. Submit samples to the Aerospace Fuels Laboratory at Wright-Patterson AFB, OH (AFTLA) for the following:

(1) All samples of petroleum products from CONUS bases not serviced by the Searsport and Vandenberg area fuels laboratories.

(2) Samples of synthetic lubricating oils from Air Force bases, regardless of geographic location.

(3) Samples requiring engine knock testing (octane rating), regardless of geographic location. Ship samples not requiring octane rating to the respective area laboratory for all other testing.

c. Sample Submission to Area Laboratories – Table 4-1 through Table 4-3 lists the shipping addresses, DODAAC, and area of responsibility for fuel testing laboratories worldwide. Include the DODAAC in the shipping address. Not every laboratory which tests fuels has the capability for testing packaged petroleum products. Refer to Chapter 8 for the area laboratory which performs reinspection and quality testing on packaged petroleum products. The laboratories shown in Table 4-1 through Table 4-3 test samples of aviation fuel, chemicals, and petroleum base lubricating oils. They also test samples of ground equipment gasoline, fuels, and oils submitted by Air Force bases within their assigned geographic area.

d. Ship samples of greases from Air Force bases, regardless of geographic location to Aerospace Fuels Laboratory at Wright-Patterson AFB, OH (AFTLA).

e. Forward all diesel fuel samples requiring testing for lubricity to the Searsport Laboratory, DET 3, WR-ALC/AFTLB.

4.3 TYPES OF SAMPLES.

NOTE

Do not draw samples from gauge/sampling hatches on tanks containing Automatic Tank Gauging (ATG) equipment if access is restricted. When access is restricted, take all samples from such tanks at ground level from the tank discharge line on the inlet side of filtration equipment.

a. Composite Sample – a single sample consisting of representative samples from more than one storage container.

b. All-Level Sample – obtained by submerging a closed sampler to a point as near the drawoff level as possible, then opening the sampler and raising it at such a rate that it is nearly full as it emerges from the liquid.

c. Top Sample – from 6 inches below the surface of the tank contents.

d. Upper Sample – from the middle of the upper third of the tank contents.

e. Middle Sample – from the middle of the tank contents.

f. Lower Sample – from the middle of the lower third of the tank contents.

g. Bottom Sample – from the lowest point of the tank contents.

h. Continuous Sample – from the line through which product is flowing giving a representative average of the stream.

i. Tube or Thief Sample – obtained as a core sample or spot sample from a specified point in a container. An all-level sample from a drum or bladder tank can be taken with these samplers.

j. Drain Sample – taken from a drain line. Drain and bottom samples are usually taken to check for water, sludge, or scale. A drain sample may be the same as a bottom sample, as in the case of a tank car.

4.4 TURBINE FUEL CORRELATION/AIRCRAFT SERVICING SAMPLE.

NOTE

At joint locations and collocated active duty/ANG units where one fuel source is available and where one Base Fuels Laboratory is shared, only the unit with the laboratory will submit the correlation/aircraft servicing sample. However, if each activity has a laboratory, both units will submit a correlation/aircraft servicing sample.

a. Air Force activities will use an Aerospace Fuels lab for correlation/aircraft servicing sample analysis.

b. Each 45 days take a one-quart and three one-gallon turbine fuel samples for correlation/aircraft servicing testing. Take these samples from a source representative of fuel serviced to aircraft. Examples are from a refueling unit, hose cart, HSV-12, filter meter pit, or a pantograph. Prepare each one-gallon sample container at least 24 hours prior to sampling by filling the container with filtered (downstream of a filter separator) fuel of the grade to be sampled. Prior to sampling, return the filtered fuel into a suitable collection container for subsequent return to inventory. Do not rinse the sample containers with petroleum ether because ether can affect the flash point of the sample.

(1) Do not overfill the containers. Leave ample space (1 inch) for expansion.

(2) Seal the containers. Leak test each container prior to shipment by inverting the container on a dry paper wipe for at least 1 hour at laboratory room temperature. Inspect the paper wipe for a dry (no leak) condition after the leak test.

(3) Verify that the AFTO Form 475 on the container(s) is/are marked for correlation/aircraft servicing testing.

c. Samples taken for correlation/aircraft servicing testing will be tested and forwarded as follows:

(1) The Base Fuels Laboratory will test the one-quart and one of the one-gallon samples for solids, filtration time, FSII, and flash point. Retain the unused portion of the one-quart sample for later retesting in the event there is a failure to correlate with the area laboratory. Keep this sample away from light. Ship the other two one-gallon samples to the area laboratory.

(2) Annotate the reverse side of the AFTO Forms 475 with the correlation results obtained when testing the one-quart and one-gallon samples for FSII, flash point, solids, and filtration time.

(3) In addition to correlation testing, the area laboratory will perform the following tests: distillation, copper strip corrosion, freezing point, existent gum, water reaction, acid number, JFTOT, and BOCLE.

d. A difference in correlation results which exceed the limits listed following this paragraph requires the base laboratory to perform an additional test on the retained sample and compare these results with the ones the area laboratory obtained. Contact DET 3, WR-ALC/AFTH if excessive variances cannot be resolved. If results are satisfactory, return the retained sample to bulk. The following correlation limits apply to JP-8 and JP-5. The limits are:

FSII	±0.02%
Flash Point	±6°F or ±3°C
Solids	±0.6 mg/l
Filtration Time	±3 min

Retain a record of these results and the area laboratory results for 6 months.

4.5 SAMPLES OF DORMANT STOCKS.

Submit samples of dormant stocks of petroleum products to the applicable laboratory for B-2 testing whenever the stocks are suspected of being off-specification, or IAW Table 6-1. Dormant stock is a product that has remained in a storage tank for the period indicated without turnover of at least two-thirds of the tank content.

4.6 SHIPPING CONTAINERS.

Submit samples to off-base laboratories in the following containers:

a. Container, Fuel Sample, NSN 8110-01-371-8315, is a one-gallon 24 gauge steel drum equipped with 1¾ inch NPT bung and seal. This container meets UN/1A1 specification and is approved for air shipment without an overpack: in accordance with 49 CFR, Paragraph 173.202(c) and IATA, Paragraph

5.0.2.12.2 and Table 5.0B when shipped under packing Group III. Clean these containers prior to initial and subsequent reuse to avoid contamination of samples. For aviation fuel samples, prior to use, soak containers for 24 hours with prefiltered fuel of the grade to be sampled. These are single trip cans, not to be returned or reused by the area laboratory.

b. Sampling Kit (Specification MIL-K-23714), for aviation fuels is reuseable. This kit has four one-quart bottles with caps, cushioned in foam and is suitable for air shipment of aviation fuel samples. The overpack is a metal container conforming to Specification MIL-D-27648. This kit is used for special application, such as fiber analysis or when sample cans are suspected of contamination.

c. Protect all AVGAS and MOGAS samples from light by using cans or brown bottles. Protect samples of jet fuel taken in clear glass containers from light.

d. After filling sample containers, insure sufficient air space exists in containers for thermal expansion. Do not use any sealing material other than the bung seal that is furnished. However, when necessary, Teflon tape is permitted.

4.7 MARKING AND IDENTIFYING SAMPLES.

a. Identify each sample immediately by attaching AFTO Form 475 to the container. If needed, send additional information in a letter to the appropriate laboratory. Annotate the AFTO Form 475, except for the portion marked FOR LAB USE, with all pertinent information. Ensure that these forms accurately identify the sample and tests required. Improperly completed forms are the most common problem associated with samples submitted to area laboratories.

b. Samples submitted in response to official requests will be identified by referring to the message or letter which required the sample. Ship overseas correlation samples on Supply Priority 09 with no Required Delivery Date (RDD). All other routine samples should be shipped on Supply Priority 02 with a RDD of 5 days. Samples will not be shipped through U.S. Postal Service under any circumstances.

c. Ship samples to CONUS laboratories via Federal Express, Purolator, UPS, etc., to expedite delivery. Samples shipped through TMO may be held for more than 5 days awaiting laboratory pickup.

4.8 SAMPLING EQUIPMENT.

Use of standard samplers or bottle catchers is not restricted to those illustrated in Figure 4-1 through Figure 4-5. Use an appropriate sampler to sample pipelines, tankers, barges, tank trucks, tank cars, drums, bladders, or storage tanks. Do not use yellow metal samplers for turbine fuel samples.

4.9 GENERAL SAMPLING PROCEDURES.

a. Take a truly representative sample. Cleanliness of equipment and the sampler's hands are extremely important. Use only lint-free materials such as Kim Wipes or soft paper towels to wipe bottles. Do not rinse bottles specifically cleaned for sediment or fiber analysis with the product before sampling.

b. Do not sample or gauge storage tanks during filling operations or within 30 minutes after product receipt to allow static charges to dissipate.

c. Underground tanks can be sampled from several locations by various methods. The preferred method is an in-line sample between the pump and filter separator during flow. As a last resort, a quick-disconnect valve for sampling with the in-line sampler can be installed in the filter separator pressure differential gauge inlet line. Do not take samples through a storage tank clean-out line or from gauge hatches that extend to the bottom of the tank, since such samples will not be representative of the product in the tank.

d. Do not sample fuel or oil contained in a servicing hose. Drain the entire hose and flush thoroughly with the product to be sampled. Do not sample containers such as drums by tilting and using a funnel placed in the sample can. Use a tube or drum thief of the type described in this chapter. For additional information on sampling, refer to API Manual of Petroleum Measurement Standards (MPMS), Chapter 8.

4.10 FUEL AND OIL SAMPLES FROM CRASHED AIRCRAFT.

a. Submit samples to the area laboratory located at Wright Patterson AFB, Ohio when requested by the local authorities or the accident/mishap investigation team.

b. It is extremely important that samples from crashed aircraft represent the fuel and oil aboard the aircraft involved and that they be submitted to the Wright Patterson area laboratory in a timely manner. Shipping data will be phoned to the laboratory to assure proper control of the samples. Jet fuel samples should be two-gallon minimum; reciprocating engine fuel, 5 gallons; and engine lubricating oil, one-quart minimum. Advise the laboratory if the fuel or oil was subjected to any outside contamination, excessive heat or fire, or if the fuel was subjected to fire extinguishing foam. Submit the following samples:

(1) Samples will be taken from each tank of the aircraft and submitted individually. In many cases, the required quantity of fuel or oil is not available from crashed aircraft and in some cases, none is available. Therefore, submit the maximum quantity available up to the required amount, for analysis. Any quantity less than the minimum will reduce the number of specification tests performed.

(2) Samples of fuel from the servicing unit or hydrant system tank used to service the aircraft prior to flight.

c. Maintain a crash sampling kit containing the following equipment:

1. Epoxy-lined Sample Cans, one-gallon, 8 each
2. Beaker, 400 milliliter, 2 each
3. Flexible Hose, Plastic, at Least 72 inches Long
4. Funnel, 1 each
5. Drum Thief, 1 each
6. Lint-free Rags or Paper Wipes
7. Pliers, 6-inch, 1 each
8. Screwdriver, Common, 8-inch, 1 each
9. Screwdriver, Phillips, 8-inch, 1 each
10. Dikes, 8-inch, 1 each
11. AFTO Form 475, Fuels and Lubricants Samples
12. Notebook, Lined
13. Pencils or Pens
14. Flashlights (explosion-proof)
15. Suction Bulb
16. Other items as directed by the FM

d. The equipment used in this kit will be cleaned and sealed. Glassware, flexible hose, funnel, and drum thief will be cleaned with petroleum ether, dried and wrapped in a protection cover i.e., Saran Wrap. The 8 one-gallon cans in the kit will be treated as follows prior to placement in the kit:

(1) Soak cans for 48 hours with one gallon of filtered turbine fuel. Return fuel to system.

(2) Place bung in the can and cover end of can with Cling Wrap or aluminum foil.

(3) Record and retain all available data on each sample container such as date of production, contract number, manufacturer, etc.

(4) Locations supporting aircraft with reciprocating engines will prepare an additional five one-gallon sample cans for AVGAS samples. Rinse cans with filtered petroleum ether. Soaking cans with AVGAS is not necessary.

4.11 CLASS A INCIDENT.

Upon notification of a Class A incident related to abnormal aircraft engine operation or failure when fuel quality could be a factor or is suspect, take the following actions:

a. Obtain representative samples from all available sources related to last servicing such as refueler bulk/operating tank, aircraft fuel cell engine test stand support tank. Take duplicate samples for retain purposes when possible.

b. Obtain sump samples from aircraft tanks and perform base level analysis IAW Paragraph 5.16 and Table 5-1. If samples fail and the cause cannot be determined, or fuel remains suspect and more data is desired, forward a two-gallon sample to the Wright Patterson AFB area laboratory for full specification testing.

Table 4-1. U.S. Military Fuel Laboratories

	Wright-Patterson AFB, OH	Vandenberg AFB, CA
Freight Address	OL DET 3, WR-ALC/AFTLA (FP2070) 2430 C Street Bldg 70, Area B Wright-Patterson AFB, OH 45433-7632	OL DET 3, WR-ALC/AFTLE (FP2075) 1747 Utah Ave, Bldg 6670 Vandenberg AFB, CA 93437-5220
Correspondence Address	OL DET 3, WR-ALC/AFTLA 2430 C Street Bldg 70, Area B Wright-Patterson AFB, OH 45433-7632	OL DET 3, WR-ALC/AFTLE 1747 Utah Ave, BLDG 6670 Vandenberg AFB, CA 93437-5220
Fax (DSN) Number (COM)	785-8088 (937) 255-8088	276-2756 (805) 606-2756
Telephone (DSN) Number (COM)	785-2106 (937) 255-2106	276-6263/5039 (805) 606-6263
Area of Responsibility	AL, AR, CT, DE, FL, GA, IL, IN, IA, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, NC, NE, NH, NJ, NY, OH, OK, PA, RI, SC, SD, TN, TX, VA, VT, WV, WI, Baffin Island, Bermuda, Eastern North West Territory, Greenland, Iceland, Ontario, Puerto Rico, and South and Central America	AK, AZ, CA, CO, ID, MT, ND, NM, NV, OR, UT, WA, and WY

Table 4-2. U.S. Military Fuel Laboratories — Europe and Southwest Asia

	Mildenhall AB, UK U.S. Air Force	Kaiserslautern, GE DESC Europe	Al Udeid AB, Qatar U.S. Air Force
Freight Address	OL DET 3, WR-ALC/AFTLF (FP2080) Bldg 725 Mildenhall AB, UK APO AE 09459-5000	DESC Europe Petroleum Lab (Com) Bldg 320 Rhine Ordnance Barracks Am Opelkreisel	379 ELRS/AFPET Air Force Petroleum Office APO AE 09309
Correspondence Address	OL DET 3, WR-ALC/AFTLF Unit 5025 APO AE 09459-5000	DESC Europe Petroleum Lab (SJ0601) (Mil) Bldg 320 Rhine Ordnance Barracks, GE APO AE 09227	379 ELRS/AFPET Air Force Petroleum Office APO AE 09309
Fax (DSN) Number (COM)	314-238-3626 44-638-543626	489-6811 49-631-536-7084	N/A N/A
Telephone (DSN) Number (COM)	314-238-2043/2797 44-638-542043/2797	489-7326 49-631-536-6812	318-437-2696 N/A
Area of Responsibility	Azores, Balkans, Crete, Greece, Italy, Mid-East, Norway, Spain, Turkey, and United Kingdom	Germany, Belgium	Iraq, Kuwait, Bahrain, Africa, Kyrgykzstan, Pakistan, Qatar, United Arab Emirates (UAE), and Uzbekistan

Table 4-3. U.S. Military Fuel Laboratories — Pacific

	Pyongtaek Korea DLA	Okinawa Japan U.S. Air Force	Hakozaki Japan U.S. Navy	Sasebo Japan U.S. Navy	Guam U.S. Navy	Pearl Harbor, HI U.S. Navy
Freight Address	Pyongtaek POL Laboratory 23rd SG, Unit 15228 APO AP 96271-0164	OL DET 3, WR-ALC/AFTLG Unit 5161 (FP2083) Kadena Air Base Japan APO AP 96368-5161	Officer in Charge Hakozaki Laboratory US FISC, Tsurumi PSC 471 FPO AP 96347-2000	Officer in Charge (Code 804) US FISC, Yokosuka PSC 476, Box 7 FPO AP 96322-1504	Commander (Code 701) US FISC, Guam PSC 455, Box 190 FPO AP 96540-1500	Director, Fuel Department Naval Supply Center Code 700 Box 300 Pearl Harbor, HI 96860-5300
Correspondence Address	Pyongtaek POL Laboratory 23rd SG, Unit 15228 APO AP 96271-0164	OL DET 3, WR-ALC/AFTLG Unit 5161 Kadena Air Base Japan APO AP 96368-5161	Officer in Charge Hakozaki Laboratory US FISC, Tsurumi PSC 471 FPO AP 96347-2000	Officer in Charge (Code 804) US FISC, Yokosuka PSC 476, Box 7 FPO AP 96322-1504	Commander (Code 701) US FISC, Guam PSC 455, Box 190 FPO AP 96540-1500	NSC Pearl Harbor POL Lab Director, Fuel Department Naval Supply Center Code 700, Box 300 Pearl Harbor, HI 96860-5300
Fax (DSN) Number (COM)	753-7289 82-333-690-7289	315-634-1429 011-81-611-734-0584	245-5485 N/A	252-4139 N/A	333-2001 N/A	471-5805 (808) 471-5805
Telephone (DSN) Number (COM)	753-7291 82-333-690-7291	315-634-3394/1602 011-81-611-734-1602	245-2733 N/A	252-4136/26 N/A	339-7106 N/A	471-9344 (808) 471-9344
Area of Responsibility		Japan, Korea, Mariana Islands, and Wake Islands				

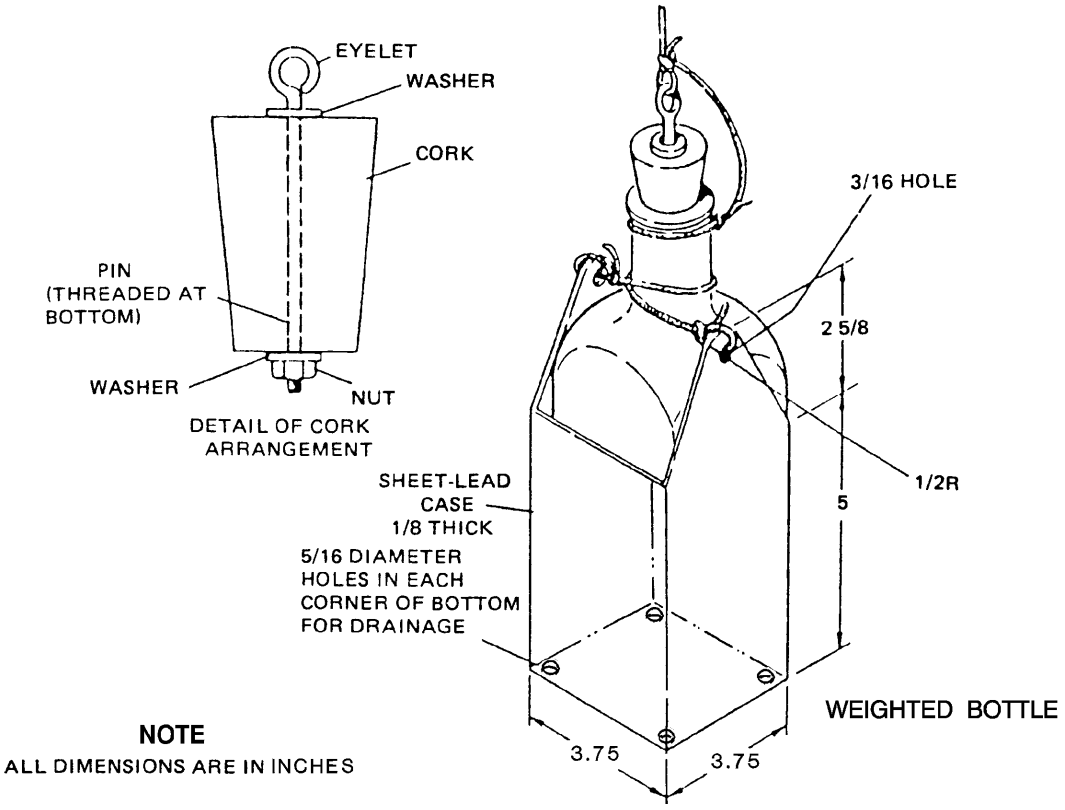


Figure 4-1. Standard Sampling Containers for Bottle Sampling

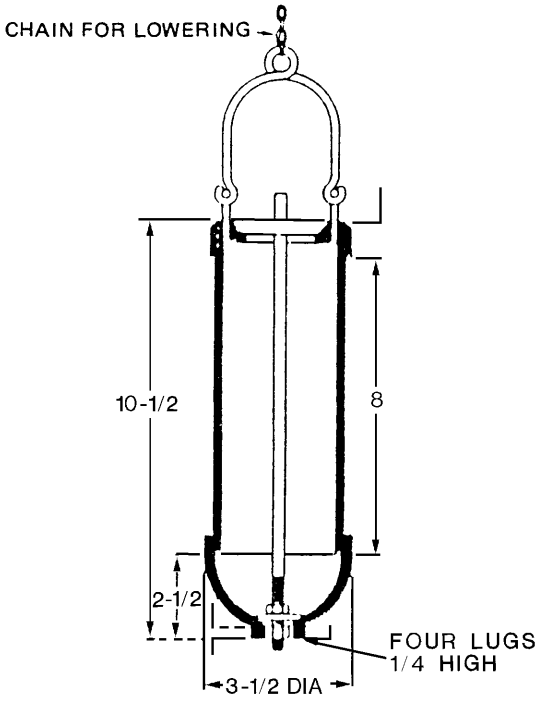


Figure 4-2. Bacon Bomb Thief for Bottom

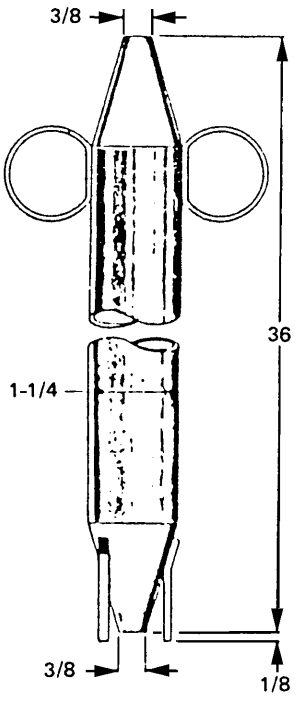
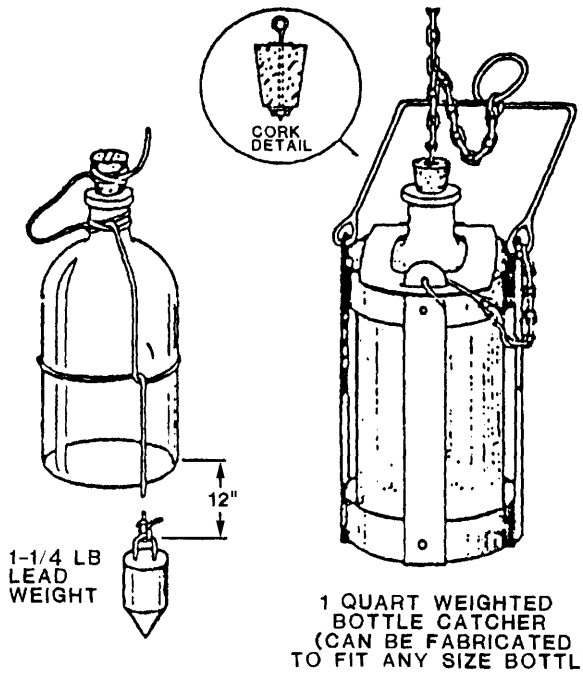
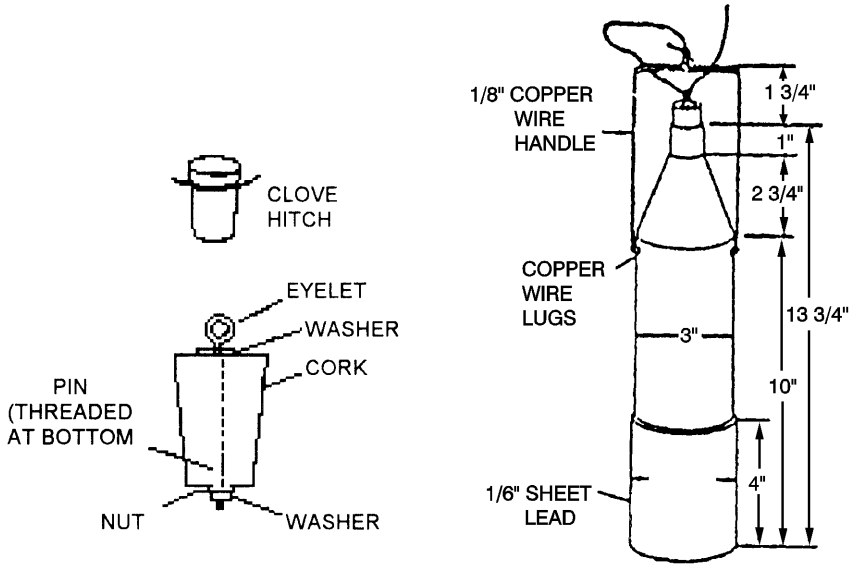


Figure 4-3. Thief for Sampling Drums



(a) 1 QT WEIGHTED BOTTLES



(b) 1 QT WEIGHTED BEAKER

Figure 4-4. Container Assemblies for Bottle or Beaker Sampler

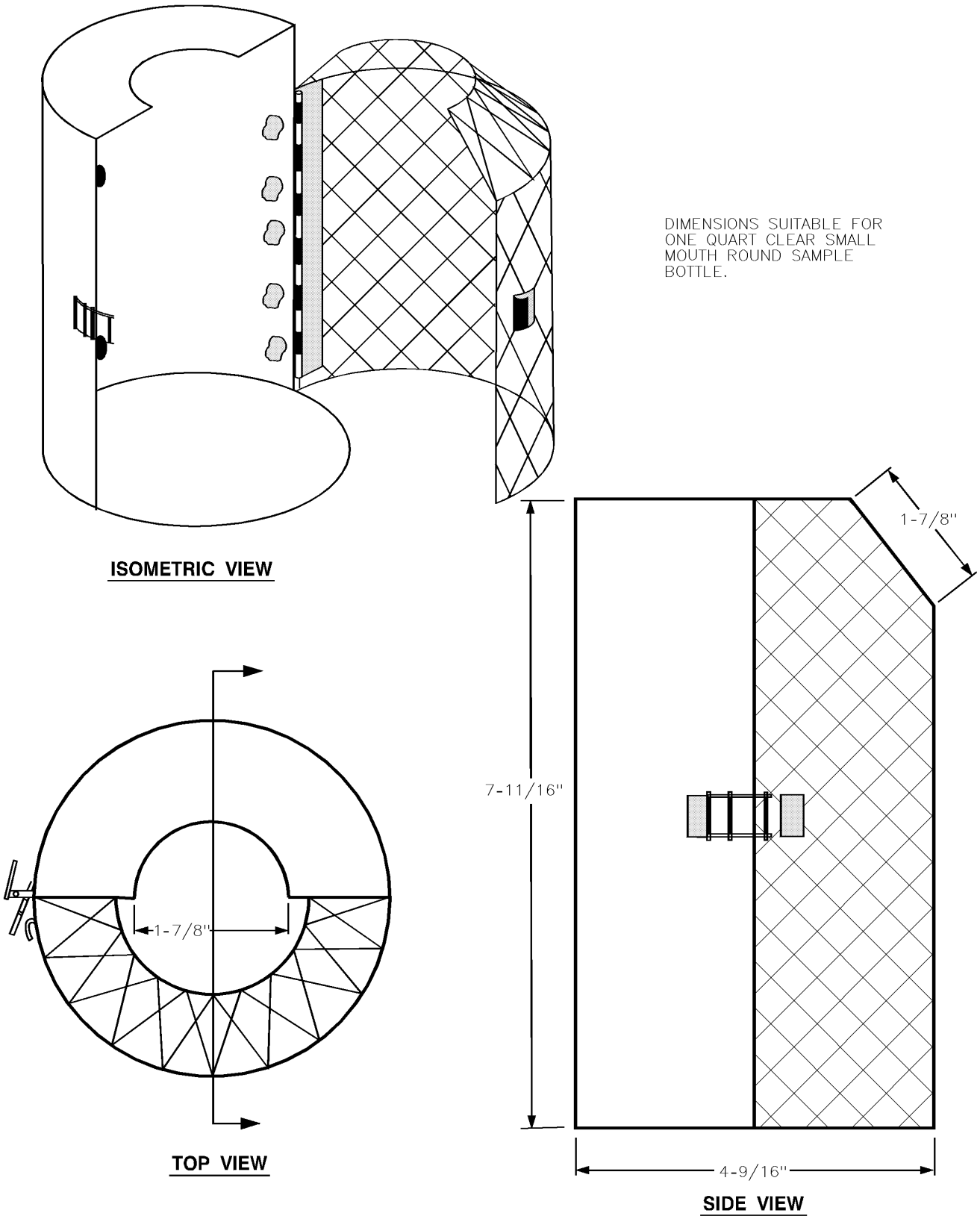


Figure 4-5. Locally Fabricated Bottle Holder (Optional Use)

CHAPTER 5
QUALITY CONTROL OF AVIATION FUELS

5.1 GENERAL.

This chapter establishes quality control procedures performed by Base Fuels personnel at Air Force installations. These procedures assure that base fuel handling systems dispense clean, dry fuel on a continuing basis. Test procedures are provided to determine water, solids, filtration time, fibers, FSII, conductivity level, gravity, flash point, cloud point, and heavy hydrocarbons. These tests are based upon approved Federal and American Society for Testing and Materials (ASTM) methods where applicable as reflected in APPENDIX C. APPENDIX B provides a consolidated list of normally required equipment and material to support a Base Fuel Laboratory.

5.2 LABORATORY TECHNICIAN QUALIFICATIONS.

FM will ensure that only properly trained personnel operate the fuels laboratory equipment and perform the required sampling. All personnel performing laboratory tests should, and at least 1 person must, receive laboratory training at the AETC Technical School. Personnel assigned to the laboratory at Andrews AFB in support of Air Force One will receive B-1 level testing and training by attending the Army Quartermaster, Petroleum Laboratory Specialist Course, 491-77-L10, Fort Lee, VA.

5.3 SAMPLING AND TESTING.

a. When sampling equipment with an in-line sampler, the equipment does not have to be grounded.

b. Obtain the minimum sample quantity required for all tests. Samples taken for visual analysis will be 1 quart. Samples taken for most of the testing requirements will be 1 gallon. In most cases, complete sample testing within duty hours of the day the sample is taken. It is permissible in certain situations to deviate from this policy if sampling and testing requirements are routine. For example, operator personnel can obtain and test conductivity levels on weekends or outside normal duty hours with minimum on-the-job training or samples can be obtained by the operator and saved for testing by laboratory personnel when normal duty hours resume. The same procedures would apply to sampling and testing requirements on receipts that occur outside of normal duty hours. When sampling and testing are considered critical to fuel reliability or when unusual conditions exist, such as an aircraft flameout, crash, etc., laboratory personnel will perform the necessary sampling and testing.

c. Each time a sample fails, a resample will be taken and another analysis performed.

5.4 PRODUCT RECEIPT — AVIATION FUEL.

Obtain samples for solids and filtration time using the bypass on the in-line sampler or a staight hose and test by the bottle method. Where it is difficult to use the in-line sampler, you may use the wire shielded sample extension hose, NSN 4720-01-230-8529, or use a Teflon or tygon hose equipped with a male fitting and internal bond wire. A wire must be soldered to the inside of the male fitting and extend internally through and 6 inches beyond the end of the tubing. The wire must be 10 – 25 gauge bare stranded flexible wire, made of stainless steel or iron. For solids only, the matched-weight monitor or bottle method may be used. When necessary to sample AVFUEL receipts prior to discharge, use the bottle method.

a. DD Form 250/Vendor Delivery Ticket shipping and receiving documents must accompany all fuel shipments. Documents should contain contract number, contractor's name, shipment number, product specification/nomenclature, API gravity, and name of the Quality Assurance Representative (QAR). If there is a problem with the document, notify the appropriate QAR.

b. Tank Truck/Tank Car – verify the tank truck/tank car contains the proper grade of product. Check seals (if required) to ensure they correspond to the information on the shipping documents (DD 250 or manifest) and are intact. Connect the header hose to the discharge manifold and open all compartment valves. After displacing fuel in the header hose, draw a one-quart (946-ml) representative sample in a clean clear jar. For tank trucks/tank cars without a common discharge manifold, a sample must be taken from each compartment.

(1) Visually examine the sample(s) for color, water, and sediment. If the product is satisfactory, proceed with the receipt operation. If the sample appears dirty, stop the operation; obtain a one-gallon sample and analyze for solids in the laboratory. If the sample is hazy or has an unusual color, stop the operation pending analysis. Use a water bath to adjust the fuel temperature to 70°F (21°C). After the sample reaches the desired temperature, swirl and examine for

visual evidence of sediment or water. The product should be clear and bright at 70°F (21°C) and contain no undissolved water. If the product is cloudy at 70°F (21°C), verify if it is water by filtering 300 ml through an AEL water detector pad. If it is not water, filter at least 1 liter through a 0.8-micron filter membrane, then process and weigh the filter membrane. Total solids should not exceed the appropriate receipt limits. If the solids content exceeds the limits specified for destination or intra-governmental transfer or the product is hazy or has an unusual color, the receipt will be delayed pending further investigation. Obtain a one-gallon retain sample and follow Product Quality Deficiency Report (PQDR) procedures for rejected shipments.

(2) Obtain a sample from each delivery source daily and analyze for FSII, SDA, solids, filtration time, and flash point. Take the sample during off-loading using an in-line sampler or a straight hose equipped as specified in Paragraph 5.4. Take the sample from the discharge manifold/receiving header as close as possible to the tank truck/tank car after displacing the header and line. After discharge ensure all compartments are completely empty by determining no flow through the visual flow gauge with each compartment valve in the open position.

c. Tanker/Barge Receipt – when tanker or barge cargoes are discharged directly into Air Force base storage systems, conduct inspection, sampling, and discharge IAW this technical order and MIL-STD-3004. Prior to discharge, take all-level samples from each vessel compartment and examine visually for color, water, and solids. If visually acceptable, use these samples to make a two-gallon minimum composite sample representative of all cargo tanks. Determine the specific or API gravity using product from the composite sample. If all visual samples are satisfactory, authorize discharge of the vessel. Retain 1 gallon of the composite sample and forward 1 gallon to the area laboratory for JFTOT and B-1 testing, excluding filtration time and particulate tests. Product may be issued prior to receiving B-1 tests results from the area laboratory provided all line samples taken during discharge are satisfactory. If the B-1 test results from the area lab are unsatisfactory, notify the DET 3, WR-ALC/AFTH, MAJCOM Fuels Office, QAR, and Defense Energy Office (DEO). Maintain a record of B-1 test results for trend analysis for 6 months. Return retain composite samples to inventory upon receipt of satisfactory B-1 test results.

(1) Single Cargo – sample 30 minutes after displacement of fuel in the receiving line, at midpoint, and 1 hour before completion of discharge. Take the samples from the receipt header as close as possible to the vessel and immediately upstream of Air Force owned filtration. Visually inspect for color, solids, water, and analyze for solids, FSII, filtration time, and SDA. Analyze a sample for flash point any time after line displacement.

(2) Split Cargo Discharges – in addition to the sample required for single product discharges, take a one-gallon, all-level sample from each product receipt tank after completion of discharge. Forward the samples to the area laboratory for B-1 and JFTOT. Product may be issued prior to receiving test results provided discharge line samples were satisfactory. Analyze a sample of each product for flash point any time after each product's line displacement.

d. Pipeline – pipeline samples are taken during receipt and represent fuel already received. Pipeline shutdowns due to off-spec product must be coordinated with the appropriate agency to cease pumping prior to valve closures.

(1) Sample each pipeline tender at the following times during the operation and perform the visual inspection and analysis specified:

(a) One hour after start, visually inspect for color, water, solids, and analyze for solids, FSII, filtration time, and SDA.

(b) If line displacement occurs prior to or after the initial 1-hour sample, obtain a sample immediately after line displacement and visually inspect for color, water, solids, and analyze for solids, FSII, filtration time, and SDA. The next required sample is 4 hours later.

(c) At each 4-hour interval after line displacement, visually sample and inspect for color, water, solids, and analyze for solids, FSII, filtration time, and SDA.

(d) Perform a flash point test on a minimum of 1 sample taken any time after line displacement, or prior to receipt termination.

(2) Use Table 5-1 for turbine fuel pipeline receipts with the following exceptions:

(a) The Central European Pipeline System (CEPS) prefiltration stations on USAFE bases are operated and maintained by the U.S. Air Force. There are no established NATO particulate and filtration time limits

on product receipts from CEPS. Prefiltration stations are equipped with 2 parallel micronic filters (rated at 2 micron) and 2 parallel filter separators (rated at 1 micron). Normally 1 micronic filter and 1 filter separator are placed on-line during receipts with automatic valve switching to the standby vessels upon attaining 20 psi differential pressure on the on-line vessels. Pipeline receipt samples will be taken upstream of the on-line micronic vessel and downstream of the on-line filter separator at the frequency established in Table 5-2 for pipeline receipts. Analyze the upstream and downstream results and suspend operations when the downstream results exceed 4.0 mg/gal or there is evidence that solids are being released downstream.

(b) The SDA limits at the point, time, and temperature of delivery into or out of the NATO Pipeline System (NPS) are as follows (ref: STANAG 7036):

Grade	Symbol	In	Out
JP-8	F-34	50 – 600	50 – 700
Jet A-1	F-35	50 – 450	50 – 450

e. Drummed Product – inspect the condition of drums for exterior damage, i.e., seals, bungs, chimes, and seams. Check drum markings against the DD Form 250. Obtain samples for visual examination if these inspections indicate discrepancies or if product contamination is suspected. Store drums horizontally on dunnage with bungs parallel to the ground.

f. Receipt of Unsatisfactory Product – when tank truck/tank car, barge/tanker, pipeline, or drum shipments are unsatisfactory upon receipt, see Paragraph 1.5, Step b.

5.5 SAMPLING REQUIREMENTS AND TEST LIMITS.

a. Test turbine fuel samples as soon as possible after taking the sample. Use the color and particle assessment method for solids analysis on all samples taken downstream of filter separators. If the color or particle assessment result is marginal or unacceptable, analyze the recheck sample by the matched-weight monitor method. Determine water content by AEL or Aqua-Glo method. When a recheck sample verifies water content or solids exceed limits, change elements in the filter separator and conduct an investigation to determine the cause.

b. When contamination downstream of aircraft servicing filter separators exceed limits, do not permit aircraft serviced from that system to fly until aircraft sumps are drained of water and the fuel within the aircraft is checked for total solids and FSII. FM will decide the acceptability of the fuel based on this determination.

c. Experience shows that a properly operated and functioning system will deliver fuel to the aircraft containing less than 1.0 mg/gal of solid contamination and less than 5 ppm water. Therefore, when either of these levels are exceeded on a continuing basis, it indicates the system is not operating as intended and FM must take corrective action to prevent exceeding use limits.

d. When the term WEEKLY is used for sampling frequency, it means a sample will be taken once every 7 days; MONTHLY means every 30 days. The sample can be taken at any time during the 24-hour clock on the day it was due.

e. Flush and sample War Readiness Material (WRM) and Fuels Mobility Support Equipment (FMSE) prior to use.

NOTE

Take samples under flow conditions. A minimum of 10 psig is required at the sampling point to permit proper flow through the sampler.

5.6 SAMPLING AND TEST PROCEDURES FOR SOLIDS.

The 3 methods used to determine solids contamination in turbine fuels are: color and particle assessment method, matched-weight monitor method, and bottle method. The bottle method determines filtration time simultaneously with solids content in a laboratory environment using an exhaust hood, vacuum pump, reducer ring, and ancillary glassware. When a laboratory or operable equipment is not available to perform the bottle method, use the match-weight monitor method. Ship match-weight monitors used for sampling under these circumstances to an alternate laboratory, designated by the MAJCOM Fuels Office, for analysis as necessary.

5.7 COLOR AND PARTICLE ASSESSMENT METHOD.

A one-gallon sample is passed through an in-line sampler containing a single filter monitor. The color of the membrane filter is compared with the color standards provided in booklet form in the Aviation Turbine Fuel Contamination Standards, Millipore Corp., P/N XX6403785, or Gammon Technical Products Filter Color and Contamination Standards for Aviation Turbine Fuels, P/N GTP-1074-AF. Make a visual color and particle assessment of the test filter membrane. If the color is 5 or greater, or the visual

particulate matter is either marginal or unacceptable as assessed with the Millipore guide, or D or greater with the Gammon guide, the sample fails. Retake another sample immediately using a matched-weight monitor or take a one-gallon sample for bottle method analysis. This method applies only to aviation fuels sampled downstream of filter separators.

a. Gammon Technical Products and Millipore Corporation manufacture the 2 types of in-line samplers used by the Air Force. The Gammon in-line sampler is equipped with an internal wire to dissipate static charges from the collection container back through the sampler connection to ground. The Millipore sampler requires the fabrication and installation of a bonding wire. An optional way of installing a suitable bonding wire is by soldering a 10 – 25 gauge bare wire internally in the base of the in-line sampler as depicted in Figure 5-3.

   (1) Perform an electrical continuity test with an ohm meter prior to initial use and every 30 days when in service. Every 30 days testing is not required on samplers that are not in use, such as samplers in TSART kits.

   (2) Test between the sampler body and the end of the ground wire contained in the discharge hose to assure continuity. Visually inspect the sampler ground wire daily when in use for frayed wires or loose connections.

b. Sampling Connection – the in-line sampler requires couplers (quick-disconnect valves) throughout the system at locations specified in Table 5-1. Insert dust plugs when the couplers are not in use.

c. Prior to sampling, insure the interior of the in-line sampler is clean.

d. Mark the monitor in a suitable manner to identify sample location prior to placing in the in-line sampler.

e. In preparation for sampling, remove plugs from the monitor and install the monitor as shown in Figure 5-3. Reassemble sampler tightly and insert bypass line. Set 3-way valve to OFF position (Figure 5-2, View C) and plug sampler into quick-disconnect valve. If a valve is not installed upstream of the quick-disconnect, this operation must be done quickly to prevent spray of product when quick-disconnect valve is open.

NOTE

Where fuel pressures are high enough to cause fuel to spray during in-line sampler hook-up, install a shutoff valve immediately upstream of the quick-disconnect valve. Recommended valve is a ball type, 300 series stainless steel, Teflon seat and seals, 1/4 inch NPT female inlet and outlet. Do not use valves containing graphite or any other stem package material. Insert the in-line sampler prior to pressurizing system whenever possible.

f. Set 3-way valve to bypass or flush position (Figure 5-2, View A), and allow approximately 1 pint of fuel to flow through the flushing line into the container. During the flushing operation, shut the valve off and on intermittently to dislodge any solid particles that may be trapped in the line. When required, allow 1 quart of fuel to flow into an appropriate container for testing of fuel system icing inhibitor, fibers, and conductivity level.

g. Place the hose into a one-gallon can, turn 3-way valve to test position (Figure 5-2, View B) and allow 1 gallon of fuel to flow through the monitor.

h. Turn 3-way valve to OFF position.

WARNING

The 1 min waiting period is required as a precaution against electrostatic discharges.

i. After sampling is completed, allow 1 min to pass; then disconnect the sampling unit from the sampling connection and replace dust caps.

j. Record test location, date, and sample volume. Return the fuel to the system as useable product.

k. Remove the monitor from the sampler, keeping it in an upright position. Remove residual fuel with the metal syringe. If sample is returned to the lab for processing, remove the residual fuel by use of the vacuum flask. Rinse the filter by filling the monitor with prefiltered petroleum ether from the solvent dispenser. Evacuate the monitor again, using the metal syringe or vacuum flask. If syringe is used, pump an additional 10 strokes in order to remove the petroleum ether.

l. When the membrane filter is rated less than or equal to a color rating of 2 and you plan to reuse the filter monitor, do not remove the top cover. To enhance accuracy when rating the filter membrane above a color rating of 2, carefully remove the top cover exposing the filter. In case the filter adheres to the top, break the seal by carefully placing an object such as a small wire through the hole in the monitor.

m. Compare and rate the color and particles on the membrane filter using the color standards booklet. The Air Force standard practice for field use is to rate the membrane wet.

n. If the color rating is less than 2, record as: A, B, or G2. If darker than 7, record as 7.

o. The sample fails if the color is 5 or greater, or the visual particle assessment is Marginal (m), or Unacceptable (u) as assessed with the Millipore guide, or D or greater as assessed by the Gammon guide.

p. When the sample fails, retake another sample immediately using a matched-weight monitor or take a one-gallon sample for bottle method analysis. This method applies only to aviation fuels sampled downstream of filter separators.

q. Report color and particle assessment ratings for each sample. If marginal or unacceptable, report the gravimetric results along with the visual rating.

r. Reuse single filter monitors one time on an optional basis when the filter membrane is rated less than or equal to a color rating of 2 and the top cover was not removed. When reusing the monitor, mark an X on the inlet plug to indicate previous use.

5.8 MATCHED-WEIGHT MONITOR METHOD.

a. Each matched-weight monitor contains two filters matched in weight to within ±0.1 milligrams. One-gallon sample of fuel is passed through the in-line sampler (Figure 5-3) containing the matched-weight monitor. Total solids contamination is determined as the increase in weight of the test (upper) filter over the control (bottom) filter after sample processing. The matched-weight control (bottom) filter is subjected to the same procedures as the test filter, thereby serving to compensate for changes in laboratory conditions during processing.

b. Mark the monitor in a suitable manner to identify sample location prior to placing in the in-line sampler.

c. Sampling procedures are the same as Paragraph 5.7, Steps c through i, plus the following steps.

d. Open the sampler, place yellow monitor cap on the top opening, remove the monitor from the sampler keeping it in an upright position, and place the red cap on the bottom opening. The monitor will contain residual fuel; therefore, the plugs must be tight to prevent leakage.

e. Record test location, date, and sample volume. Return the fuel to the system as useable product.

f. Determination of Total Solids.

(1) Ground the vacuum pump, filtration apparatus, drying oven, balance, and waste fuel container prior to and when in use. Electrical equipment is grounded to the building electrical service common ground system when plugged in with a serviceable 3-prong (ground) electrical plug, therefore no other ground wires are required. Ground waste fuel containers by extending a ground wire with clamps from the container to the laboratory common ground system.

(2) Remove plugs and place monitor, spoke side down, on the one-hole stopper in the filter flask attached to a vacuum source. Turn on vacuum source and pull through existing fuel.

(3) Shut vacuum source OFF.

(4) Fill monitor with filtered petroleum ether; turn on vacuum and pull solvent through.

(5) While vacuum is still on, remove cover of monitor and carefully rinse the outer edges of the filter with petroleum ether. The stream should be slight so as not to disturb the contaminants on the filter.

(6) In all cleaning procedures which require washing with a filtered solvent, the solvent is dispensed through the solvent dispenser. This assembly includes a wash bottle, a hand pump attachment, filter holder, 25-millimeter diameter, and 0.45-micron filter paper. The solvent is filtered as it is dispensed. Inspect before each day's operation and replace the filter as needed.

g. Use any convenient means to remove the filters from the monitor. Exercise care to insure no solids are lost from the filter. An apparatus used to assist in removing the filters from the monitor consists of a wooden block with a steel rod in the center. Stops are provided so that when the monitor is lowered, the two filters are raised slightly above the monitor's edge. This permits the removal of the filters with a pair of forceps.

(1) Separate the filters while wet. Place filters in a petri dish with the cover slightly ajar to allow volatiles to escape while affording protection from contamination. Place petri dish in a 90°C (194°F) oven for 30 minutes. Remove petri dish from oven and place near the balance for a minimum of 30 minutes. The petri dish cover should be slightly ajar, but still protecting the membrane filters from atmospheric contamination.

(2) Clean balance pans and zero the balance daily. On a two-pan balance, place test filter on left pan, the control filter on right pan and record the difference in weight as the total solids content in milligrams. Weigh filters separately on the single pan balance.

(3) Total Solids Content – the difference between the weights of the test and control filters is the weight of the total sediment in the sample filter. Sample size is normally 1 gallon. However, if less than 1 gallon is filtered, calculate the total sediment by using the following equation:

$$\text{Sediment (mg/gal)} = \frac{\text{Weight of sediment in sample in milligrams (mg)} \times 3785 \text{ (ml/gal)}}{\text{Sample size in Milliliters (ml)}}$$

h. Do not reuse filter monitor cases for particulate sampling after the cases are opened. Reassembly of the cases can result in particle bypass.

5.9 BOTTLE METHOD.

NOTE

Protect samples taken in bottles from light, as the exposure to Ultraviolet (UV) light causes additive dropout and gum formation in the fuel.

a. Use this method to determine the solids content and filtration time property of fuel. The filtration time test is an indicator of the filterability characteristics of fuel and is controlled to prevent premature replacement of filter separator elements due to excessive differential pressure. High filtration time fuel that does not necessarily have a high solids content may result in a rapid build-up of differential pressure.

b. Flush new and sample containers last used for solids testing with a minimum of 500 ml of filtered turbine fuel.

c. Fuels laboratories will use a stainless steel funnel when performing tests specified by this technical order. Sampling techniques are not specified since samples will originate from various sources using several sampling devices; however, take a representative sample regardless of device used.

d. Grounding/Bonding of Filtration Apparatus.

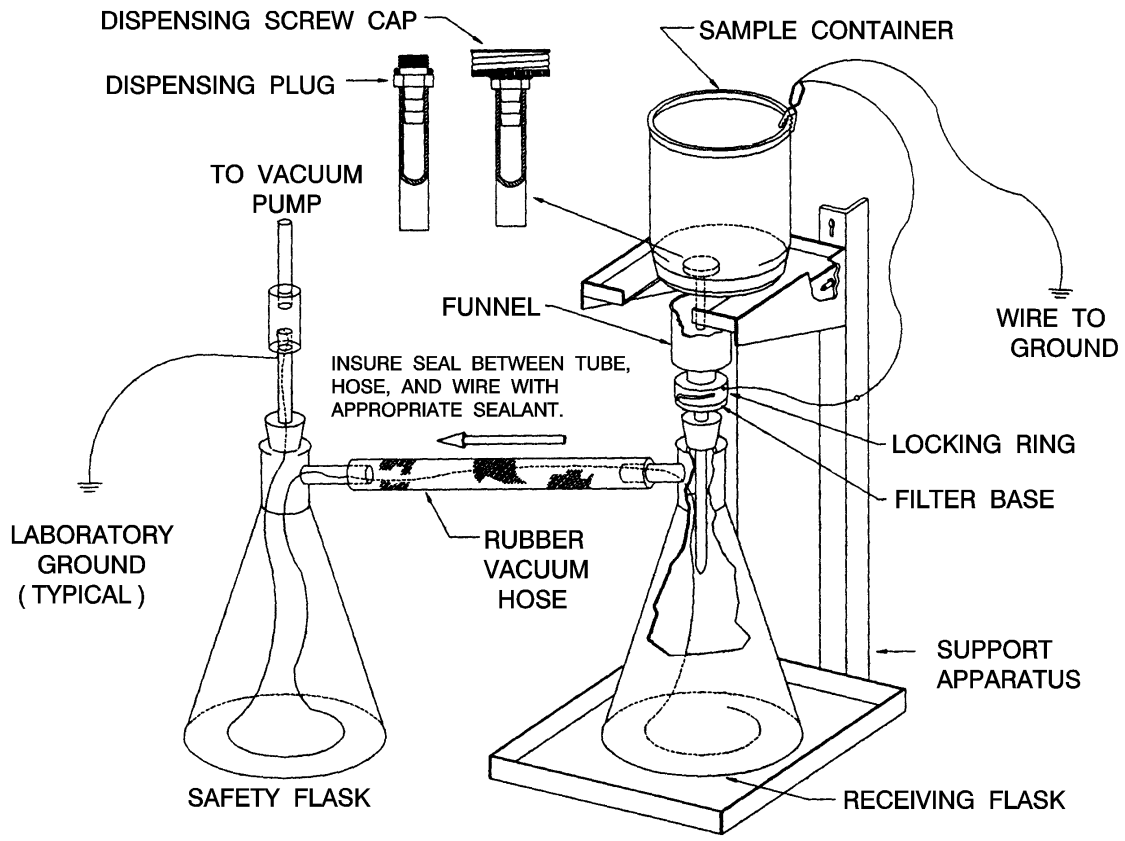


Figure 5-1. Apparatus for Determining Total Contaminant

(1) The filtration apparatus becomes a prolific static generator as fuel is pulled through the membrane filter. Consequently, the flasks and apparatus must be grounded/bonded to the laboratory common ground: ground/bond wire, Nos. 10 thru 19 (0.912 – 2.59 mm) bare stranded flexible, stainless steel or copper installed in the flasks and grounded as shown in Figure 5-1. If a metallic flask(s) is used instead of glass, the flask(s) must be grounded. To determine which grounding/bonding connection is required, per form the following test:

(a) With the membrane filter placed in the filter holder, perform a continuity test using a multimeter connected between the top of the stainless steel funnel and the bottom portion of the filter holder. If there is continuity between the two points, the meter should read full scale, or less than 10 ohms resistance. When this occurs, the grounding/bonding system illustrated in Figure 5-1 is satisfactory.

(b) When there is not continuity between the top and bottom parts of the stainless steel filtration apparatus with the membrane filter in place, an additional jumper wire must be installed to bond the filter holder with the stainless steel funnel. Drill and tap the bottom of the filter holder to accommodate the installation of a small screw to fasten the jumper wire. Then ground to the laboratory common ground utilizing a small alligator clip.

(2) Bond metal cans during fuel transfer operations. The in-line sampler, with the required bonding wire installed in the discharge hose, provides adequate bonding of the fuel and container during sampling.

e. Filtration Apparatus Grounding – To verify that bonding of all parts of the filtration apparatus is complete an electrical continuity test shall be conducted using a multimeter. There must be 10 ohms or less resistance between any two points.

f. Test Procedures for Solids and Filtration Time.

(1) Clean the stainless steel filtration apparatus by rinsing with petroleum ether.

(2) Place new membrane filters in a petri dish with lid slightly ajar and put in an oven for 30 minutes at a temperature of 90°C (194°F). Remove petri dish from oven and place near the balance for a minimum of 30 minutes. The petri dish cover should be slightly ajar, but still protecting the membrane filters from atmospheric contamination.

(3) Using forceps, place 1 membrane filter on the balance and weigh to the nearest 0.0001 gram. Do not use a filter weighing in excess of 90 mg when determining filtration time.

(4) When determining filtration time, center the paper flow reducer ring on the filter base and place the membrane filter directly over the reducer ring. (The reducer ring is not used for testing JP-5.) Clamp or screw top funnel into place.

(5) Clean the exterior top portion of the sample container with petroleum ether to assure that no contaminants are introduced. Assure that fuel temperature is between 64°F (18°C) and 86°F (30°C). Fuel temperature limits do not apply if test is for solids only. Record fuel temperature. Immediately prior to filtering the fuel, shake the sample to obtain a homogeneous mixture.

WARNING

Volatile fuels such as AVGAS, MOGAS, and Jet B or mixtures having flash points below 100°F (38°C) must be transferred from the sample container to the funnel without pouring. See Figure 5-1.

(6) Do not place open fuel samples in the area of the nonexplosion-proof vacuum pump switch. Install pumps at a higher elevation than the sample or test apparatus.

(7) With the vacuum off, pour approximately 200 ml of fuel into the funnel. Turn vacuum on and record starting time. Continue filtration of the one-gallon sample, periodically shaking the sample container to maintain a homogeneous mix. Note the vacuum in inches of mercury approximately 1 minute after start. To obtain meaningful results, the vacuum must be in excess of 20 inches of mercury. A properly operating vacuum system will develop approximately 25 inches of mercury. Throughout filtration, maintain a sufficient quantity of fuel in the funnel so that the membrane filter is always covered.

(8) Report the filtration time in minutes expressed to the nearest whole number. If filtration of the one-gallon is not completed within 30 minutes, stop the test and measure the volume of fuel filtered. In this case, report the filtration time as 30 minutes + volume of fuel filtered.

(9) When determining solids content, shut off vacuum and rinse the sample container four times with approximately 50 ml of filtered petroleum ether each time and dispense into the filtration

funnel. Turn vacuum on and filter the rinse. Turn vacuum off and wash the inside of the funnel thoroughly with petroleum ether. Filter and then repeat the petroleum ether rinse of the funnel with the vacuum off and allow the ether to soak the filter for approximately 30 seconds. Filter again and with vacuum on, carefully remove the top funnel and rinse the periphery of the membrane filter by directing a gentle stream of petroleum ether from the edge to the center, taking care not to wash contaminants off the filter. Maintain vacuum after final rinse for a few seconds to remove the excess petroleum ether from the filter. After rinsing the sample container with petroleum ether the container shall be capped in preparation for subsequent sampling use.

(10) Using forceps, carefully remove the membrane filter from the filter base, separating it from the reducer ring. Place filter in a clean petri dish with cover slightly ajar and dry in an oven at 90°C (194°F) for 30 minutes. Remove petri dish from oven and place near the balance for a minimum of 30 minutes. The petri dish cover should be slightly ajar, but still protecting the membrane filters from atmospheric contamination.

(11) Weigh the filter to the nearest 0.0001 gram, taking care not to disturb the contaminants on the surface of the membrane filter. Report the total solids content in mg/gal by using the following formula:

$$\text{Total solids mg/gal} = \frac{\text{Weight gain of filter in milligrams} \times 3785 \text{ (ml/gal)}}{\text{Volume of sample filtered in milliliters}}$$

(12) If the sample exceeded the 30 minute filtration time and a portion of the fuel was not filtered, measure the volume of fuel filtered and apply the formula above.

(13) To determine filtration time and not the total solids content, perform the test by omitting Steps f (10) through (12).

(14) To determine the total solids content and not the filtration time, do not use the flow reducer ring and omit the reporting procedures or controls pertaining to the filtration time analysis (such as vacuum and temperature).

(15) Rapid change in fuel temperature affects filtration time results. Therefore, allow samples to reach equilibrium with ambient temperature of the laboratory. When samples fail filtration time after being rapidly preheated or cooled, resampling is necessary. Allow retest samples to gradually reach equilibrium with the laboratory temperature prior to testing.

(16) See Figure 5-8 for recommended support apparatus.

5.10 FREE WATER DETERMINATION.

a. General.

(1) The Aeronautical Engine Laboratory (AEL) Water Detector and the Gammon Aqua-Glo Water Detector are portable instruments used to quantitatively determine the free water present in fuel. The principle of both instruments is the reaction between free water in the fuel and a dye, sodium fluorescein, on the detector pad. Due to the subjectivity of the AEL Water Detector, the Gammon Aqua-Glo Water Detector is the preferred method. When viewing the detector pad by the AEL method, a distinct yellow color is noted if free water is present. Compare this color with an AEL printed standard to determine the quantity of free water present in ppm. Replace and date the AEL printed standard annually. The Gammon Aqua-Glo Water Detector comes equipped with a permanent fluorescing standard. To determine water content, the operator adjusts the diaphragm lever arm until the fluorescing standard and the test pad show equal brightness. Water detector procedures by either method are applicable for dynamic line samples only; that is, taking the fuel sample directly from the fuel system and through the test pad without exposing the sample to the atmosphere or to a sample container.

(2) Clean the stainless steel Millipore detector pad holder with a dry cloth or paper material. This detector pad holder can be used with both Millipore and Gammon in-line samplers.

(3) Ungrounded one-quart polyethylene or clear glass sample bottles may be used with the AEL and Gammon Aqua-Glo free water detector.

(4) Do not remove the test pad from the hermetically sealed package until ready for use. The operator will inspect every water detector pad before use. Discard the pad if it is not orange in color. A yellow or slightly yellow pad indicates water exposure.

b. Procedures for Determination of Free Water by the AEL Method.

(1) Remove the pad from the wrapper with forceps and place it in the stainless steel detector pad holder, orange side up. Do not handle detector pads with fingers. Press the detector holder

together tightly. With the inlet side up, place the holder in the in-line sampler and screw the top of the sampler down tightly. Connect sampler to sample point.

(2) Turn the valve on the in-line sampler to the FLUSH position (see Figure 5-2, View A) and flush 300 ml of fuel. After flushing, turn the valve to TEST position (see Figure 5-2, View B) and pass through the pad 300 ml of fuel into a graduated container. At completion of operation, turn valve to OFF position and disconnect sampler.

(3) Remove the detector pad holder from the in-line sampler. Connect the metal syringe to the detector pad holder and remove excess fuel. Using forceps, take the pad from the holder. If necessary to transport the pad to the laboratory, return the pad to a dry used AEL detector pad envelope. Fold the open end of the envelope to secure and protect the pad. Or you may use a clean, dry (used) matched-weight or single monitor filter case with plugs inserted.

SAFETY PRECAUTION

Eye exposure to the ultraviolet light should be minimized as much as possible.

(4) Remove the pad from the holder placing the orange side up in the free water detector slide depression. Light the bulb by holding the switch in the ON position and insert the slide containing the pad. For detectors equipped with 2 switches, light the bulb by pressing both switches simultaneously, release the red switch while holding the front switch in the ON position and insert the slide containing the pad. Compare the fluorescence of the detector pad to that of the standards. Free water is indicated in parts per million by the standards. If the detector pad and the standards do not exactly match, estimate as closely as possible.

(5) Clean the reuseable equipment and discard the used pads in a solid waste container.

(6) Use and maintenance of the AEL Water Detector battery and battery case is optional.

c. Procedures for Determination of Free Water by the Gammon Aqua-Glo Detector:

(1) Calibration – an encapsulated pad labeled CALIBRATING STANDARD is provided in an envelope in each kit. Note the SET number on the back of this pad and place it in the test pad window with the colored side facing the instrument. Turn on the ultraviolet lamp and then press the switch button on the photocell comparator. Adjust the light modulating lever until the red pointer is steady at the zero (0) in the center of the meter. To eliminate errors caused by clearance in the mechanical linkage always move the 8 modulation lever in the same direction when zeroing the photocell comparator for calibration or testing. If the reading obtained does not agree with the SET number on the calibrating standard, remove the plug screw on the side of the photocell comparator (at the 45° bend), insert a small screwdriver and adjust the photocell comparator as necessary. Repeat the above procedure until the rating obtained agrees with the calibrating standard SET number. The instrument should be calibrated prior to first use each day. Return the calibrating standard to the envelope in the kit. Do not use a calibrating standard from another kit. Each calibrating standard is matched to a fluorescing standard.

(2) Attach the test pad holder assembly to the fuel line quick-disconnect coupler. Open the toggle valve by lifting the handle. Allow at least 300 ml of fluid to pass through the assembly. Opening and closing the valve several times will insure better flushing. Remove the assembly after flushing.

(3) Open the test pad holder assembly and insert a test pad using forceps. Be sure that the orange colored side of the pad is facing upstream.

(4) Pass 500 ml of fuel through the pad, accurately measuring the test sample quantity. If the reading exceeds the scale and it is desired to get an approximate water content, a sample volume down to 100 ml may be used. When this is done, multiply the result by a factor determined by dividing the volume used in ml into 500 ml.

(5) Remove the test pad from the holder using forceps and press between dry paper blotters or absorbent towels to remove excess fuel. To blot, press firmly 3 or 4 times with heel of hand.

(6) For maximum accuracy, determine the test result as soon as possible after sampling. If the test pad is not read immediately after sampling place in a desiccator to prevent moisture pickup from the air. However, avoid ratings made on dried test pads since they will give high and erroneous results. Conversely, rating an unblotted pad will give a low reading.

(7) Using forceps, put the pad into the instrument test pad window. Turn on the lamp and press the photocell button. Continuously zero the photocell comparator by adjusting the light modulating lever until there is a steady reading for 10 –

15 seconds. Turn off the instrument light immediately after use to conserve battery power.

5.11 FSII TEST PROCEDURES.

The 2 standard methods used to determine the % of DIEGME present in turbine fuels are the HB (B2) and BRIX scale refractometers. Both refractometers measure the refractive index of a water extract.

a. The B2 FSII test kit is the preferred method and only its test procedures are covered herein. Refer to the Brix operating instructions shipped with the equipment for use of the Brix. The Brix and the B2 methods are essentially the same. While all methods correlate, the refractometer methods require no chemical or environmental support and are quick and easy without any sacrifice of accuracy. Field tests are performed in a bare base environment using the ancillary equipment in the kit with available light. When using the refractometer in the fuel laboratory, the use of glassware in lieu of field ancillary equipment is optional. The refractometer is a very delicate optical instrument and should be handled with extreme care to avoid damage to the lens and window elements. Test procedures for the B2 FSII test kit and refractometer are:

(1) In a clean and dry quart container, obtain at least a one-pint fuel sample.

(2) Set up support stand, rod, base, and ring, and fill an aluminum dish ½ full of water (tap water is satisfactory).

(3) Calibrating the Instrument – hold the refractometer in a horizontal position. Lift the prism coverplate, make sure the prism and coverplate are clean. Use the plastic dipstick or a common plastic stirring rod to prevent scratching the prism, place a few drops of the water sample from the aluminum dish on the face of the prism. Close the coverplate and observe through the eyepiece the location of the line in the viewer. Use the plastic dipstick to adjust the set screw (in the base) so that the line intersects the zero line of the scale. Clean coverplate and prism. Calibrate daily or when changing test water.

(4) Transfer 160 ml of the the fuel to the separatory funnel.

(5) Using a syringe/pipette, add 2 ml of water to the separatory funnel. Cap the funnel and shake vigorously for 5 minutes. Then place it in the ring stand and allow a minimum of two minutes for fuel water separation.

(6) Carefully open the separatory funnel drain cock so that a trickle of the water layer can be taken in a clean, dry aluminum dish or glass container. Two or 3 drops is sufficient.

NOTE

Fuel containing thermal stability additive (JP-8+100) emulsifies water into very small droplets. These droplets along with some fuel will collect at the bottom of the funnel. To separate the water from the fuel, continually tilt and rotate the dish allowing the surface tension to remove the foam from the fuel water mixture, soaking up excess foam with a wipe until water is all that remains.

(7) Reading the Instrument – lift the prism coverplate, with the dipstick or a plastic stirring rod place a few drops of the test sample on the face of the prism. Hold the instrument in a horizontal position. Keep the coverplate in contact with the prism and point the instrument toward a window or other illuminating source. Look through the eyepiece and take a reading at the point where the dividing line between light and dark crosses the scale. Record the results on a work sheet or the AFTO Form 150.

(8) Properly dispose of the unused fuel and water. Wash the glassware in soap and water and air-dry.

b. Procedure for Determining DIEGME FSII Content – to determine the DIEGME content, using the refractometer method, read the M or DIEGME scale which is located on the left side of the optical viewing area.

c. FSII Use Limits – the use limit for FSII in turbine fuel, except JP-5, is 0.07% minimum – 0.20% maximum per volume. Since the maximum specification level is 0.15% by volume, concentrations of 0.20% or above are very unusual. FSII concentrations of 0.07% or greater will lower the freeze point of small quantities of free water in fuel systems to a point as low as that of the fuel itself under all operating conditions and locations. The icing protection decreases as the FSII content decreases. Fuel containing below 0.07 FSII content will be upgraded as soon as possible to use limits by commingling available stocks, local injection of FSII during intratank transfer, or by resupplied stocks. When it is necessary to upgrade the FSII content of fuel in tanks, refer to the instructions provided in APPENDIX A.

d. Since FSII is preferentially soluble in water, prevention and elimination of water from fuel transport and storage systems is essential. Any tank which shows an abnormal increase in water content must be sampled immediately to determine the

FSII content of the product. Follow provisions of Step b to determine suitability and corrective action. Fuel containing FSII in the range of 0.05% to less than 0.07% may be used only if operational necessities dictate. If necessary to use such fuel, fuel will be sampled during refueling of aircraft and analyzed quantitatively for the presence of free water by a water detector method. If free water in excess of 5 ppm is detected, aircraft must be defueled and then refueled with fuel containing less than 5 ppm free water.

5.12 CONDUCTIVITY ADDITIVE TEST PROCEDURES.

a. General.

(1) The terms conductivity additive and SDA are used interchangeably when referring to Stadis 450. Conductivity is reported as either Picosiemens per Meter (pSm) or more commonly, Conductivity Units (CUs). These 2 measuring units are equal.

(2) The response of these additives in fuel is unpredictable due to several factors. Most corrosion inhibitors decrease the conductivity level. Cleanliness of the fuel also affects response, i.e., the cleaner the fuel, the better the response. Nitrogen content is also a factor. A high nitrogen level will depress the conductivity value. Temperature is perhaps the most significant factor, the higher the temperature the higher the conductivity and vice versa. Table 5-4 gives an indication of the effects of temperature on conductivity level. Use this table as a general guide since all fuels do not follow the table exactly.

(3) The 2 models of the EMCEE conductivity meter are the analog and the digital. Only the digital is discussed herein. The probes do not require cleaning if the meter zeros prior to test. If the meter does not zero, clean the probe by rinsing with isopropyl alcohol and air-dry. If this does not correct the problem, check the batteries. If the meter still does not function properly, send to PMEL. T.O. 33K-1-100 requires periodic PMEL calibration of both conductivity meters.

(4) Sampling containers for the conductivity test are not restrictive, except for the use of plastic. In most cases, the conductivity of the fuel will not change appreciably within several hours (except for temperature variation) if the sample is protected from light in cans or in brown or foil wrapped bottles. The preferable time is 2 minutes after sampling to obtain the actual conductivity level of the fuel at ambient temperature. However, it is permissible to test up to 24 hours after sampling, provided the sample is within 10°F (6°C) of the fuel temperature when the sample was taken, has not been taken in a clear glass container, and has been protected from direct sunlight.

(5) Cold temperatures adversely affect the accuracy of meters. Thus keep exposure time of these meters to cold temperatures to a minimum. When performing on site tests, keep the meter inside the vehicle and in coat pocket while traveling to the sampling location. Discontinue CU testing when fuel temperatures drop below 32°F (0°C).

b. Conductivity Meter Model 1152.

(1) The EMCEE digital model 1152 conductivity test meter is UL approved for use in hazardous locations when equipped with 3 6-volt alkaline photo-electronic batteries. The digital meter has a range from 0 – 2000 CUs.

(2) Calibration. Attach probe to bottom connector on conductivity meter. Depress MEASURE (M) switch with probe out of fuel sample. In approximately 3 seconds the reading should be zero +1 division. If reading is outside of this limit, remove probe and recheck zero by depressing MEASURE switch. If the meter does not zero, clean the probe by rinsing with isopropyl alcohol and air-dry, attach the probe and retest for zero. If the meter does not zero, with the probe now attached or if the meter did not zero in the above check without the probe, turn the meter into PMEL. If the meter with probe attached zeroes, depress CALIBRATE (C) switch. After 3 seconds, the meter reading should be 10 times the number stamped on the probe, within ±5 numbers.

Example

Probe No. = 40
Meter Reading = 400 ±5
or
395 – 405

If CALIBRATE is outside of the limits listed, the meter must be turned into PMEL for calibration.

(3) Conductivity Test – insert probe in fuel to upper holes and depress MEASURE switch. Report reading after 3 seconds. Due to polarization of the fuel sample, the reading after about 3 seconds will decrease or fluctuate. Record the fuel temperature and CU value. Sample need only be large enough to cover both electrodes, but must be representative of the product being tested.

(4) Battery Replacement – the Model 1152 has an internal battery checking circuit. If batteries are weak, the meter will read for a short time and shut off. If batteries are too low, the unit will not turn on. When battery replacement is indicated, remove the 4 screws holding the backplate exposing the battery housing at the top of the meter. Remove the 2 screws on the battery housing and set the housing cover to one side. Observe the polarity markings and insert 3 new batteries. Replacement must be (3) 6-volt alkaline photo-electronic batteries. Any other battery replacement will invalidate the UL Intrinsically Safe Rating. Replace back panel and check zero and calibration.

5.13 FIBERS TEST PROCEDURES.

a. General.

(1) Fibrous particles in jet fuel samples are difficult to detect by visual techniques. Fibers are all sizes, but usually 5 – 20 microns in diameter and up to ½ inch long. One inch is 25,400 microns.

(2) While all filter separator elements can generate fibers, the required sampling locations for fibers in Table 5-1 concentrate on controlling fibers in filter separator vessels closest to the skin of the aircraft. Most separators are installed on mobile equipment, but in the case of Type III and IV hydrant systems using the pantograph, the vessel is fixed. This also applies to Panero systems using a pantograph with the last filter separator vessel being in the pit.

NOTE

Vessels equipped with absorption media elements do not require a fiber analysis.

(3) After element change, sample the filter separator vessel for fiber content. Take the sample after passing a minimum of 2000 gallons through the vessel. In the case of refuelers or hose carts, clean the single-point nozzle strainer prior to sampling and inspect after 2000 gallons thruput. Collection of fibers in the strainer or in excess of 10 fibers per quart in the sample will require strainer cleaning and passing an additional 2000 gallons through the vessel. Continued high fiber content in the strainer or in the sample is cause to change elements. For fixed vessels, 2 samples in excess of 10 fibers per quart require element change.

(4) There are several areas of concern in obtaining a truly representative sample for detection of fibers. Entrance of airborne fibers during sampling and insufficient flushing of the sampler often give erroneous results. Utmost care is required in these areas to assure test reliability. Do not wipe outside of sample bottles, especially the neck, with rags or cloth.

b. Test Procedures.

(1) Clean one-quart bottles and caps with soap and water, rinse with tap water, then with distilled or demineralized water. Use a solvent dispenser and dispense approximately 100 ml of filtered isopropyl alcohol to remove water from the bottle and cap.

(2) Using a solvent dispenser and 50 ml of filtered petroleum ether for each rinse, rinse the bottles twice. After the second rinse, replace cap without drying the bottle. Place aluminum foil over top of bottle to prevent dust and lint from getting under cap.

(3) Sample product into the bottle using bypass on the in-line sampler. After samples are obtained in the one-quart bottle, visually examine for fibers, by placing a light behind the bottle after swirling and viewing the bottle perpendicular to the light. Count all fibrous particles. A fiber is defined as a particle having a length to diameter ratio of 20:1 or more and having a length of 100 microns or more.

5.14 FLASH POINT.

There are three methods to determine flash point. These are Pensky-Martens, TAG, and Seta Flash. Pensky-Martens, ASTM Method D93, is the preferred method and is the only flash point test detailed herein. For bases that have the TAG or Seta Flash, it is permissible to continue using either method. For the TAG method refer to ASTM Method D56; for the Seta Flash method refer to ASTM D 3828.

a. Summary of Method – a brass test cup filled to the inside mark with test specimen and fitted with a cover, is heated at a slow constant rate with continual stirring. An ignition source is directed into the test cup at regular intervals with simultaneous interruption of the stirring until a flash is detected. The flash point is the temperature when a flame appears and instantaneously propagates itself over the entire surface of the test specimen.

b. Equipment required is listed in APPENDIX B.

c. Preparation of Apparatus – support the tester on a level, steady table. Unless tests are made in a draft-free room or compartment, surround the tester on 3 sides with a shield, each section approximately 18 inches wide and 24 inches high. Tests made in a laboratory hood or in any location where

drafts occur are not reliable. Thoroughly clean and dry all parts of the test cup and its accessories before starting the test, to ensure the removal of any solvent which had been used to clean the apparatus.

d. During flash point determination, tightly cap all flammable chemicals or fuels and place under operating exhaust hood or in a closed cabinet.

WARNING

Low flash point products may explode.

e. The temperature of the test cup and test specimen shall be at least 32°F (18°C) below the expected flash point.

WARNING

Gas pressure should not be allowed to exceed 3kPa (12 inch) water pressure. Exercise care when using a gas test flame. If it should be extinguished it will not ignite the vapors in the test cup, and the gas for the test flame that then enters the vapor space can influence the result. Meticulous attention to all details relating to the ignition source, size of test flame, or intensity of the electric igniter, rate of temperature increase, and rate of dipping the ignition source into the vapor of the test specimen is desirable for good results.

f. Fill the cup with sample to be tested on the level indicated on the filling mark. Place the lid on the cup and place in the heater. Take care to have the locking device properly engaged. Insert the thermometer. Light the test flame, and adjust it to a diameter of 5/32 inch, or switch on the electric igniter and adjust the intensity IAW the manufacturer's instructions. Supply heat at such a rate that the temperature, as read on the thermometer, increases 9°F (5°C) – 11°F (6°C) per minute. Turn the stirrer 90 – 120 rpm, stirring in a downward direction.

g. Apply the ignition source when the temperature of the test specimen is 41° ± 9°F (23° ± 5°C) below the expected flash point and each time thereafter at a temperature reading that is a multiple of 2°F (1°C). Discontinue the stirring of the test specimen and apply the ignition source by operating the mechanism on the test cover which controls the shutter so that the ignition source is lowered into the vapor space of the test cup in 0.5 seconds, left in its lowered position for 1 second, and quickly raised to its upward position. If a flash point is detected on the first application, the test shall be discontinued, the result discarded, and the test repeated with a fresh test specimen. The first application of the ignition source with the fresh test specimen shall be 41° ± 9°F (23° ± 5°C) below the temperature at which a flash point was detected on the first application. If the sample flashed at room temperature, the result will be reported as less than that temperature. When the apparatus temperature has cooled down to less than 130°F, remove the test cover and the test cup and clean the apparatus as recommended by the manufacturer.

h. Record the observed flash point as the temperature at the time the test flame application causes a distinct flash in the interior cup.

i. Correction of observed flash point test results is optional except when:

(1) Performing correlation flash point tests.

(2) There is controversy regarding whether the flash point meets the minimum specification requirement, i.e., receipt sample.

(3) The flash point is critical to aircraft fuel system purging operations.

(4) Flash point test is being performed at bases 1,000 feet or more above sea level or when the barometric pressure is higher than 760 mm Hg/29.92 in./Hg (average sea level barometric pressure).

j. Correction of observed flash point will be based upon the difference between 760 Millimeters of Mercury (mm Hg), which is the average barometric pressure at sea level, and the uncorrected ambient barometric pressure. Many aneroid barometers, such as those used at weather stations and airports, are corrected to give sea level readings. These must not be used.

(1) The normal change in barometric pressure for each 1000 feet altitude above sea level equals an approximate increase of 1.5°F (0.83°C) flash point correction. This known can be used to determine the approximate corrected flash point, if desired, when exercising the option not to calculate the correction.

(2) Using an aneroid barometer, record the ambient barometric pressure at the time of the test. When the pressure differs from 760 mm Hg/29.92 in./Hg, correct the observed flash point as follows:

F = Observed flash point, °F

C = Observed flash point, °C

P = Ambient barometric pressure, mm Hg

Ambient barometric pressure, in./Hg, multiplied by 25.4 = mm Hg

For example, 29.13 in./Hg x 25.4 =
739.902 mm Hg, rounded to 740 mm Hg

Corrected flash point = F + 0.06 (760 − P)

Corrected flash point = C + 0.033 (760 − P)

Example:
Observed flash point is 132°F. Ambient barometric pressure is 29.13 in./Hg

29.13 x 25.4 =
739.9 mm Hg, rounded to 740 mm Hg

Corrected flash point =
132° + 0.06 (760 − 740) =
132° + 0.06 (20) = 132° + 1.2 = 133.2°F

5.15 DETECTION OF HEAVY HYDROCARBONS IN AVGAS.

a. General − this method is used for the detection of trace amounts of turbine fuel or other heavy hydrocarbons (JP-8 or heavier) in aviation gasoline. Two samples of aviation gasoline of the same grade are used; one of a known quality (reference), and the other of the fuel to be tested. If AVGAS is stored in only one tank, take two one-gallon samples from this tank. Forward 1 gallon to the area laboratory for analysis. The other one-gallon sample will be retained, tagged, and used as REFERENCE FUEL if the area laboratory analysis indicates fuel is satisfactory. If more than 1 tank is used to store AVGAS, a composite five-gallon sample from the tanks will be taken. Transfer 2 gallons of the five-gallon composite into 2 clean one-gallon sample containers. Retain and tag 1 gallon for REFERENCE FUEL. Send one-gallon sample to the area laboratory for analysis. Return the remaining 3 gallons of the composite sample to bulk. Use the one-gallon retain sample for reference fuel if the area laboratory indicates fuel is satisfactory. The procedures for obtaining the reference fuel sample and submission of the AVGAS sample to the area laboratory for analysis will be repeated every 45 days.

b. Chromatography Test Procedures.

(1) Figure 5-4 and Figure 5-5 show the locally made apparatus to be used in this test. Measure 25 ml each of reference fuel and sample fuel into separate 50 ml beakers. Add approximately 5 mg of dye to each beaker and mix by swirling. From the 50 ml beakers, transfer 10 ml of dyed fuel to separate 10 ml test tubes. Fill the tubes to the top lip. Insert the test tubes into the holder with the unknown or suspected sample placed on the right side.

(2) Lower a ¼ inch side by 8-inch long strip of chromatographic paper into the test tube until it touches the bottom of the test tube. Affix the top of the chromatographic paper to the holder in an extended position. After 15 minutes, record the height of the fuel on the 2 chromatographic papers.

(3) Contamination is indicated by the height of the fuel on the chromatographic paper of the unknown or suspected sample versus the height of the reference fuel on its paper. If the height of the test fuel stain on the chromatographic paper is greater than ¼ inch above the height of the reference fuel stain, the fuel should be considered contaminated. This indicates a contamination level of approximately 5%.

c. When the storage tank sample indicates failure, a sample from the tank will be submitted to the area laboratory for analysis. Do not issue fuel before results are obtained. Results from the area laboratory indicating heavy hydrocarbon contamination will require checking each delivery conveyance for heavy hydrocarbons. Receipts will not be delayed pending results, but the receiving portion of the one-gallon sample taken for the test will be forwarded to the area laboratory for test if the result at base level shows contamination. If the area laboratory confirms contamination, an all-level sample from the receiving bulk tank will be forwarded to the area laboratory to determine suitability for use. Corrective action will also require notifying the QAR.

5.16 PROCEDURES FOR AIRCRAFT SUMP SAMPLES.

The requirement and procedures for sampling and submitting aircraft sump samples to the Base Fuels Quality Control Laboratory are contained in the aircraft technical orders. In addition, aircraft maintenance organizations/Command Post may request analysis of aircraft sump samples any time contamination is suspected. Samples will be obtained by aircraft maintenance personnel and processed in the Base Fuels Laboratory.

a. One-quart samples will be processed for solids content by the bottle method as detailed in Paragraph 5.9.

b. If the sample contains visual free water, the membrane filter will be washed with 50 ml of distilled or demineralized water after the final petroleum ether rinse.

c. Report solids in Milligrams (mg) per quart. DO NOT convert weight to mg/gallon. If the quantity of sample analyzed is less than 1 quart, report that quantity along with the total solids. Compare the membrane to the Millipore Membrane Particle Assessment Guide, copyright Shell Oil Company, 1964. The limit for particle assessment is G. If the visual assessment fails, determine the total solids. Solids are considered excessive if they exceed 4.0 mg/qt. Both weight and visual assessment must exceed the limits in order to consider the sample a

failure. In the event of failure, analyze a one-quart recheck sample to verify results. If the retest passes visual assessment the requirement to process and weigh the membrane is waived.

d. When solid limits are exceeded, examine the membrane filter under a microscope. Follow procedures described in Paragraph 5.21 and attempt to identify the contaminants. If a more detailed analysis of the contaminants is necessary, forward the membrane filter to the area laboratory.

e. Report aircraft number, sample location, and solids results to the maintenance organization. If the sample was submitted for other than routine purposes, determine FSII content (use the limits in Table 5-1, Item 26), in addition to the solids analysis.

f. When solids content of aircraft sump samples exceed limits specified in Step c, flushing the aircraft is suggested. Sump samples should again be obtained and analyzed to determine the adequacy of the aircraft flushing procedures.

g. Failure to follow proper procedures when taking sump samples has resulted in aircraft being unnecessarily grounded. See APPENDIX D at end of the technical order for the correct sump sampling procedures. Copies of the Millipore Membrane Particle Assessment Guide, copyright Shell Oil Company 1964, used for evaluating sump samples, are available for DET 3, WR-ALC/AFTH, DSN: 785-8070.

5.17 AIRCRAFT ELECTROSTATIC FIRE INCIDENT.

When an aircraft experiences an internal fuel tank/cell electrostatic ignition incident, maintenance personnel will obtain sump samples from the aircraft and the Base Fuels Laboratory will analyze the samples. In addition to the solids analysis specified in Paragraph 5.16, determine the conductivity of the fuel. Report results to the maintenance organization and DET 3, WR-ALC/AFTH.

5.18 PROCEDURES FOR SOAKING, FLUSHING, AND SAMPLING NEW HOSE.

WARNING

ELECTROSTATIC IGNITION HAZARD

Flushing the over-the-wing hose by positioning the hose on top of the refueler and opening the over-the-wing nozzle into the manhole creates a serious safety hazard. Because of the electrostatic hazards involved, avoid the spraying or free falling of fuel into a tank or refueler tank.

The following instructions are applicable to new discharge hoses installed downstream of the final filtration on aviation fuel facilities, vehicles, and equipment. Inlet hoses, such as those installed on hose carts and off-loading/fillstand transfer hoses are not affected. Comply with these instructions immediately after installation of the hose and prior to returning the vehicle or equipment to service.

a. Pressurize the hose with fuel and soak for 3 hours. Flush the hose with at least 500 gallons of fuel by circulating through the bottom loader or by transferring to a defueler. Take a one-gallon sample at the nozzle under flow conditions using the single weight monitor. The color rating must be less than 5 and the particle assessment better than marginal. If either color or particle assessment fails, resample during circulation using the matched-weight or bottled method. The result must be 2.0 mg/gal or less. If this sample fails, proceed to Step b.

b. Soak hose for 10 hours. Discard fuel in hose into suitable container. Flush hose with 500 gallons of fuel and after circulating this quantity, sample at the nozzle by the matched-weight or bottle method. If sample exceeds 2.0 mg/gal, return vehicle/equipment to maintenance and replace hose. Obtain disposition instructions for military specification hose or API 1529 hose from WR-ALC/LEV, Robins AFB, GA.

5.19 API GRAVITY DETERMINATION.

Use an API Gravity to determine volume correction, aircraft fuel weight, floating roof displacement calculations, or multiple product pipeline operations. This measurement is most accurate when the temperature is near the standard temperature of 60°F (16°C); however, gravity determination may be made between 30°F (–1°C) and 90°F (32°C). The hydrometer and cylinder should be approximately the same temperature as the sample to be tested.

a. Pour the sample into the clean graduated cylinder. Place the cylinder containing the sample in a vertical position in a location free from air currents that would affect the hydrometer floating freely away from the walls of the cylinder. The temperature of the surrounding medium should not change more than 5°F (3°C) during the test.

b. Lower the hydrometer gently into the sample. When it has settled, depress it about 2 scale divisions into the liquid, then release, keeping the rest of the stem dry since unnecessary liquid on the stem changes the weight of the instrument and

affects the result. Spin the hydrometer slightly upon release which allows it to float freely away from walls of the cylinder. Allow the hydrometer to become completely stationary and all air bubbles to come to the surface.

c. Read the hydrometer to the nearest scale division. The correct reading for transparent liquids is that point on the hydrometer scale at which the principle surface of the liquid cuts the scale. Determine this point by placing the eye slightly below the level of the liquid and slowly raising it until the surface, first seen as a distorted ellipse, appears to become a straight line cutting the hydrometer scale. (See Figure 5-7.)

d. Record the temperature of the sample to the nearest °F.

e. When thermo-hydrometers are used, stir the sample by carefully raising and lowering the hydrometer. The temperature can be read after the hydrometer reading has been observed.

f. Correct the observed API Gravity to API Gravity at 60°F (16°C) using ASTM D 1250, Volume I, Table 5A for JP-4 and commercial Jet B. To correct the observed API Gravity of JP-8 to API Gravity at 60°F (16°C), use ASTM D 1250, Volume II, Table 5B. Record the observed API Gravity/Temperature and corrected API Gravity at 60°F (16°C).

g. To correct measured volume to 60°F (16°C) net volume, use ASTM D 1250, Volume I, Table 6A for JP-4 and commercial Jet B. To correct measured volume of JP-8 to 60°F (16°C) net volume, use ASTM D 1250, Volume II, Table 6B.

5.20 VISUAL INSPECTION PROCEDURE.

a. Although one of the simplest procedures in the quality control of fuels, visual examination is a good indication of suitability for use. An absence of visual foreign material is a good indication that the fuel is suitable for use, whereas a failure by visual examination requires laboratory analysis. Prior to obtaining a visual sample, clean a clear glass bottle by washing with soap, rinse with hot water, then with distilled or demineralized water, and dry.

b. Check for proper color and all forms of visual contamination by swirling the sample so a vortex is formed. Experience will dictate what can be considered excessive sediment. When checking for water 1 or 2 drops of water-soluble food coloring may be added to the sample to aid in distinguishing water from the fuel. Coloring is unnecessary when dyed fuel is being examined. Very fine suspended solids or water will render the product hazy. If the sample is questionable, a laboratory analysis will be made to verify the quantity of contaminant.

5.21 MICROSCOPIC ANALYSIS.

If excessive solids are obtained, either upon receipt, within the base system, or in aircraft, examine the filter by microscope to identify the types of contaminants and assist in pinpointing their source. Examination of particles under magnification takes significance after the operator gains knowledge through repeated use of the microscope. Examination of known particles will familiarize operators with what to look for on the filter. Obtain samples of the following materials and examine them under the microscope so that the operator becomes familiar with their appearance: fibers or lint, aircraft reticulated foam pieces, sand, dirt, metal shavings, and rust.

5.22 DISPOSITION OF SAMPLES.

Return unused portions of fuel samples to storage or dispose of IAW T.O. 42B-1-23. Every effort will be made to use this product for its original purpose. Fuel samples containing petroleum ether used for rinse purposes should not be considered as waste fuel. This product should be returned to storage unless otherwise contaminated.

5.23 RECORD OF LABORATORY RESULTS.

a. The results of all laboratory tests will be recorded and maintained for 6 months. Actions related to fuel quality such as sample failures, filter separator element changes, and new hose tests will also be annotated. A record of danger tags placed on equipment removed from service for quality reasons will be maintained. When an automated program is not available, utilization of the AFTO Form 150 is required.

b. Retention of Filters – when a sample contains excessive sediment, retain the filter for review and training purposes. A convenient method to save the filter is to place it on a cardboard file holder, identify it, and cover the filter with scotch tape. Another method is to place it in a plastic pocket. Retain a variety of filters to provide an overview of local contaminants. Excess filters may be discarded as a matter of discretion.

5.24 CLEANING GLASSWARE.

a. Maintenance of laboratory glassware by hand washing using a mild detergent cleaning solution followed by adequate rinsing will normally be sufficient. However, if glassware appears dirty, cloudy, and/or large weight changes are experienced during test conditions, then the glassware should be cleaned by using a strong detergent cleaning solution.

b. A strong detergent solution may be needed to remove deposits from glassware. A suitable detergent solution using a detergent concentrate or equivalent can be mixed as follows:

(1) A mild detergent solution for hand washing in a sink can be obtained by using 2 fluid ounces of detergent per gallon of water.

(2) A strong detergent solution can be obtained by using 25 ml of detergent concentrate with 1000 ml of distilled or demineralized water. Stir to mix in a suitable container. Immerse the glassware in the solution for at least 30 minutes. Solution temperatures while cleaning should be between 185°F (85°C) – 200°F (93°C) for best results. Use a suitable container with the hot plate.

(3) Detergent solutions should be discarded and a fresh solution made every 30 days. During its use, a small volume of water will be lost due to evaporation, add enough distilled or demineralized water to bring the volume back to original size and continue to use. The detergent solution may become cloudy when cold; however, this will not effect the cleaning ability.

(4) Rinse all glassware 3 times with tap water. Perform a final rinse using distilled or demineralized water then air or oven dry.

5.25 SECURE FUEL TEST PROCEDURES.

NOTE

Contact DET 3, WR-ALC/AFTH for questions concerning SECURE FUEL.

a. These procedures apply only to the primary and spare aircraft performing these duties. Support aircraft will be serviced the same as any other transient aircraft. JP-8 is the primary fuel for use in these aircraft. If JP-8 is not available, alternate fuels (commercial Jet A-1, commercial Jet A, and JP-5) may be used. Tests listed in Table 5-6 must be performed on representative samples taken downstream of the final filtration (filter separator) from refueling units or hydrant operating tanks prior to issuing fuel to these aircraft. Those tests within the capability of the base fuels laboratory should be performed on base. Testing beyond the capability of the base laboratory should be performed at an Air Force area laboratory. If time does not permit testing at the area laboratory, contact the DEO Quality Manager for assistance in obtaining local laboratory testing using a DESC service contract.

b. Supplies of secure aviation fuel will be sealed and secured, after sampling, according to AFI 31-101, Air Force Installation Security Program.

5.26 DORMANT STORAGE TESTING.

See Paragraph 6.11.

5.27 AVGAS RECEIPTS.

a. On receipt, take an all-level one-quart sample from the tank truck prior to off-loading. On each receipt a specification test report from the supplying refinery shall accompany the delivery and be provided to the receiving activity.

b. With the one-quart sample, perform a visual test for color, water, and sediment. The color shall be the same as reported on the refinery test report and there should be no water or solids present. The visual test must pass before off-loading product into storage. Protect the one-quart sample from sunlight. A heavy hydrocarbon test IAW Paragraph 5.15 shall be performed on the one-quart sample. This test should be accomplished soon after off-loading the fuel into storage.

c. Every 30 days take an all-level sample from each storage tank or R-11 functioning as both a storage tank and an issuing unit and perform a heavy hydrocarbon test. If the test fails, forward a one-gallon sample to the area laboratory for specification testing. Place the applicable storage tank/R-11 on QC hold status.

d. On initial fill and every 45 days thereafter, submit a one-gallon all-level sample from the storage tank(s) or R-11(s) to the area laboratory for specification testing. Use the results of the test as the reference for the heavy hydrocarbon test (provided the test results from the area laboratory are satisfactory).

Table 5-1. Turbine Fuel Sampling Requirements and Test Limits

Item	Sample Point	Test	Test Limits	Sample Frequency
1.	Pipeline Receipts.			
2.	Pipeline Header upstream of Air Force owned filter separator if installed, or downstream of contractor owned filtration, whichever is applicable.	Visual for color, water, and solids.	Clear and bright and visually free of water and solids.	Each receipt, 1 hour after start, after line displacement, and at each 4-hour interval thereafter.
		Solids	See Table 5-2. Use bottle method.	
		FSII	See Table 5-2.	
		Conductivity	See Table 5-2.	
		Filtration Time	See Table 5-2. Use bottle method.	
		Flash Point	See Table 5-2.	Each receipt, any time after line displacement.
3.	Downstream of Air Force owned filter separator.	Solids/DP	Less than 4.0 mg/gal. Use bottle method. The downstream must be less than the upstream.	Every 7 days or next receipt. Take 1 downstream sample in conjunction with any 1 of the upstream samples, compare the results.
		Filtration Time	15 minutes	
4.	Tank Truck/Tank Car Receipts.			
5.	Tank Truck/Tank Car Receiving Header, upstream of Air Force owned filter separator, if installed.	Solids	4.0 mg/gal when receiving direct from a refinery or a destination contract. 6.0 mg/gal on intragovernmental transfers. Use bottle method.	One sample daily from 1 T/T or T/C from each supplier. Locations receiving fuel that has been hand doped or had a single compartment doped with SDA will comply with Paragraph A.4.
		FSII	See Table 5-2.	
		Conductivity	See Table 5-2.	
		Filtration Time	See Table 5-2. Use bottle method.	
		Flash Point	See Table 5-2.	
6.	Downstream of Air Force owned filter separator.	Solids/DP	Less than 4.0 mg/gal. Use bottle method. The downstream must be less than the upstream.	Every 7 days or next receipt. Take 1 downstream sample in conjunction with any 1 of the upstream samples; compare the results.
		Filtration Time	15 minutes	
7.	Tank Truck/Tank Car discharge manifold.	Visual for color, water, and solids.	Clear and bright and visually free of water and solids.	Each T/T or T/C on receipt after line displacement.
8.	Tanker/Barge Receipts.			
9.	Gauge for water and take all-level sample from each cargo tank. Retain for composite.	Gauge with water finding paste. Visual for color, water, and solids.	Clear and bright and visually free of water and solids.	Prior to acceptance for discharge.

Table 5-1. Turbine Fuel Sampling Requirements and Test Limits - Continued

Item	Sample Point	Test	Test Limits	Sample Frequency
10.	Create two one-gallon composite samples using the all-level samples.	Specific or API Gravity.	Specification limits.	Discharge product after conformance with visual tests, free water removal, and verification of correct gravity range.
	Composite samples.	Retain 1 and forward 1 to area laboratory for JFTOT and B-1 testing, excluding time filtration and particulate tests.	N/A	Each vessel.
11.	Off-loading header line as near as possible to the vessel and upstream of Air Force owned filter separator.	Solids	See Table 5-2. Use bottle method.	Each receipt, 30 minutes after fuel displacement of sea-line. Also at midpoint and 1 hour prior to completion.
		FSII	See Table 5-2.	
		Conductivity	See Table 5-2.	
		Filtration Time	See Table 5-2.	
		Flash Point	See Table 5-2.	Any time after line displacement.
12.	Downstream of Air Force owned filter separator.	Solids/DP	Less than 4.0 mg/gal. Use bottle method. The downstream must be less than the upstream.	Every 7 days or next receipt. Take 1 downstream sample in conjunction with any 1 of the upstream samples, compare the results.
		Filtration Time	15 minutes	
13.	Storage Tanks (when multiple tanks are on a common manifold take one sample from the fillstand or transfer line).	Conductivity	50 – 700 CU	Every 14 days.
		FSII	0.07 – 0.20%	Every 14 days.
14.	Tanks with capacity of 50,000 gallons or less that receive product direct from suppliers. If tanks are manifolded to one discharge line, rotate and sample a different tank every 14 days. Maintain this sequence of sampling until all tanks in the group are sampled.	FSII	0.07 – 0.20%	Every 14 days.
		Conductivity	50 – 700 CU	Every 14 days.
15.	Hydrant System and Fillstand Operating Tanks.	FSII	See Table 5-2.	Monthly from each hydrant system operating tank downstream of filter separator.
		Conductivity	See Table 5-2.	Monthly from each hydrant system operating tank downstream of filter separator.

Table 5-1. Turbine Fuel Sampling Requirements and Test Limits - Continued

Item	Sample Point	Test	Test Limits	Sample Frequency
16.	Bulk Storage Truck Fillstand. Downstream of filter separator.	Solids/DP	Color and particle assessment method. If either color or particle assessment fails, limit is 4.0 mg/gal on a recheck sample using a matched-weight monitor.	Every 7 days. If fillstand is inactive for more than 1 week, sample during the first refueler fill. Sample during first refueler fill after F/S elements are changed.
		Water	10 ppm	
17.	Refueler/Hose Cart. Downstream of filter separator.	Solids/DP	Color and particle assessment method.[1] If either color or particle assessment fails, limit is 2.0 mg/gal on a recheck sample using a matched-weight monitor.	Every 7 days. Equipment not used within 7 days will be sampled prior to or during the first servicing operation. After F/S elements are changed, sample prior to or during first servicing operation. After maintenance that can affect fuel quality is performed, or there is a fuel grade change, the equipment will be sampled prior to servicing aircraft.
		Water	10 ppm	
		Fibers	10 per quart	After F/S elements are changed, sample prior to or during first servicing operation.
		Conductivity	See Table 5-2.	Take a minimum of 1 sample per week from 1 unit. Schedule sampling to assure all active units are sampled monthly. Units not used within 30 days will be sampled prior to the first servicing operation.
18.	Dedicated Defuel Equipment.	Solids/DP	Color and particle assessment method.[1] If either color or particle assessment fails, limit is 2.0 mg/gal on a recheck sample using a matched-weight monitor.	Monthly or when defuel vehicle is converted to refueling service, sample prior to or during first servicing operation. After elements are changed, sample prior to or during first operation.
		Water	10 ppm	
		Fibers	10 per quart	After F/S elements are changed, prior to or during first servicing operation.

Table 5-1. Turbine Fuel Sampling Requirements and Test Limits - Continued

Item	Sample Point	Test	Test Limits	Sample Frequency
19.	Transfer line downstream of filter separator between bulk storage and hydrant tanks.	Solids/DP	Color and particle assessment method.[1] If either color or particle assessment fails, limit is 4.0 mg/gal on a recheck sample using a matched-weight monitor.	Every 30 days. After element change, sample during first transfer operation.
		Water	10 ppm	
20.	Type I and II Hydrant Systems Pumphouse: Downstream of each filter separator at hydrant system pumphouse including filter separators on system truck fillstands.	Solids/DP	Color and particle assessment method.[1] If either color or particle assessment fails, limit is 4.0 mg/gal on a recheck sample using a matched-weight monitor.	Every 30 days on active systems. Systems inactive for more than 1 month will be sampled prior to aircraft servicing.[2] After element change, sample prior to or during first servicing operation.
		Water	10 ppm	
21.	Type I Filter Meter Pits: Downstream of each filter separator in use for servicing aircraft.	Solids/DP	Color and particle assessment method.[1] If either color or particle assessment fails, limit is 2.0 mg/gal on a recheck sample using a matched-weight motor.	Every 7 days. Equipment not used within 7 days will be sampled prior to or during the first servicing operation. After F/S elements are changed, prior to or during first servicing operation.
		Water	10 ppm	
		Fibers	10 per quart	After F/S elements are changed, prior to or during first servicing operation.
22.[3/4]	Type III, IV, and V Hydrant Systems.			
23.	Downstream of each inlet filter separator to operating tanks.	Solids/DP	Color and particle assessment method.[1] If either color or particle assessment fails, limit is 4.0 mg/gal on a recheck sample using a matched-weight monitor.	Every 30 days, except when receiving directly from a supplier, then sample every 7 days. Equipment not used within this period will be sampled prior to or during the first servicing operation. After F/S elements are changed, prior to or during first servicing operation.
		Water	10 ppm	Every 30 days, except when receiving directly from a supplier, then sample weekly. Equipment not used within this period will be sampled prior to or during the first servicing operation. After F/S elements are changed, prior to or during first servicing operation.

Table 5-1. Turbine Fuel Sampling Requirements and Test Limits - Continued

Item	Sample Point	Test	Test Limits	Sample Frequency
24.	Downstream of each outlet filter separator from operating tanks.	Solids/DP	Color and particle assessment method.[5] If either color or particle assessment fails, limit is 2.0 mg/gal on a recheck sample using a matched-weight monitor.	Every 7 days. Equipment not used within 7 days will be sampled prior to or during the first servicing operation. After F/S elements are changed, prior to or during first servicing operation.
		Water	10 ppm	
		Fibers	10 per quart	If the final filtration is in the pumphouse (where a pantograph is used for refueling), perform a fibers test after filter elements are changed.
25.	Aircraft Sumps.	Visual for color, water, and solids.	Clear and bright without visual solids or free water.	Prior to defueling only when suspected contamination exists.
26.	Aircraft Sumps.	Solids	See Paragraph 5.16, Step c.	When required, after aircraft engine flameout, or aircraft electrostatic fire.
		FSII	0.05 – 0.20%/vol	
		Conductivity	50 – 700 CU	Aircraft electrostatic fire only.

[1]The failure criteria when comparing the membrane filter to the Color Standards are as follows: Color – 5 or greater; Particle Assessment – if there are visual particles present the sample fails. Retake the sample using a matched-weight monitor or take a one-gallon sample for bottle method analysis. Test limits on retake samples are addressed by specific Item Number in this table.

[2]Take samples downstream of filter meter pit, at the outlet or hose cart after displacing the line. Determine solids by color and particle assessment method. Determine free water by AEL or Aqua-Glo method. Do not exceed use limits.

[3]Pantograph/Hydrant Hose Truck (HHT)/Hydrant Servicing Vehicle (HSV).

[4]Type III, IV, and V hydrant loops, flow-throughs, in-shelter facilities, and constant pressure pits and lines that are built off of hydrant loops are of noncorrosive materials such as stainless steel, fiberglass, or aluminum. No flushing is required except after line maintenance or sample failure.

a. When using a pantograph in conjunction with a filter separator, filter meter pit, hose cart, or refueler, sample every 7 days, downstream of the filter separator.

b. When using a pantograph on a Type III, IV, or V system and the last installed filter separator is at the pump pad, sample the filter separator and the hydrant loop every 7 days at the pantograph arm. Sampling each pantograph is not required.

c. When using HSV/HHT with a Type I, II, or III system, sample the HSV/HHT filter separator every 7 days.

[5]The failure criteria when comparing the membrane filter to the 2 scales is as follows: Color – 5 or greater; Particle Assessment – worse than acceptable.

[6]The samples listed in this table are the minimum required, local conditions may require a more aggressive sampling plan.

Table 5-2. Aviation Turbine Fuel Limits

Test	Specification	Receipt [1]	Use
JP-8			
Solids (MAX)	1.0 mg/liter	6.0 mg/gal	2.0 mg/gal
FSII	0.10 – 0.15	0.09 – 0.20	0.07 – 0.20
Conductivity [2]	150 – 450	50 – 700	50 – 700
Filtration Time (MAX)	15 min	20 min	15 min
Flash Point (MIN)	100°F (38°C)	100°F (38°C)	100°F (38°C)
JP-5			
Solids (MAX)	1.0 mg/liter	6.0 mg/gal	2.0 mg/gal
FSII	0.15 – 0.20	0.10 – 0.20	0.07 – 0.25
Conductivity	[3]	[3]	[5]
Filtration Time (MAX)	15 Min [4]	20 Min	15 Min
Flash Point (MIN)	140°F (60°C)	140°F (60°C)	136°F (58°C) [6]

[1] Specification limits apply to receipts from a destination contract.
[2] Discontinue testing when the fuel temperature is below 32°F (0°C).
[3] SDA is not required by the specification.
[4] The flow reducer ring is not required by the specification.
[5] SDA is required when JP-5 is used for purging or issue to Air Force tactical aircraft. The limit is 50 – 700. Discontinue testing when the fuel temperature is below 32°F (0°C).
[6] A minimum of 140°F (60°C) is required for issue to Navy aircraft.

Table 5-3. AVGAS Sampling Requirements and Test Limits

Sample Point	Test	Test Limits	Sample Frequency
Pipeline.	Visual for solids, water, and color.	No excessive solids, water, or discoloring.	On receipt 15 minutes after start of transfer.
	Solids (if visual suspect).	6.0 mg/gal	Same as above.
	Heavy hydrocarbon	¼ inch or less	Same as above.
Tank Truck/Tank Car.	Visual for solids, water, and color.	No excessive solids, water, or discoloring.	Each delivery conveyance on receipt.
NOTE Bases that use refuelers to receive or store AVGAS should test for heavy hydrocarbon content from the commercial tank trucks each time fuel is received. The visual sample taken prior to unloading can be used for this test. Complete testing prior to servicing aircraft. Do not detain tank truck pending results of test.			
Lower third of tank content.	Solids (if visual suspect).	6.0 mg/gal	Same as above.
Bulk storage tanks (an all-level sample).	Heavy hydrocarbon	¼ inch or less	Every 30 days.
Filter Separators: downstream of each filter separator on refuelers, hose carts, and filter meter pits.	Visual for solids, water, and color.	No excessive solids, water, or discoloring.	Every 7 days.
	Solids/DP	Particle assessment method. If particle assessment is worse than acceptable scale, limit is 2.0 mg/gal on a recheck sample using the matched-weight or bottle method.	Every 30 days. After element change, sample prior to or during first servicing operation.

5.28 AVGAS ISSUES FROM DRUMS.

a. Upon initial receipt of drummed AVGAS, take an all-level one-quart sample, and one (one-gallon) sample from a drum selected at random from each batch/lot. With the one-quart sample(s) perform a visual test for color, water, and sediment. The color shall be the same as reported on the refinery test report and there shall be no water or solids present. Protect the one-quart sample from sunlight and mark as RETAIN after performing the visual inspection. Forward the one-gallon sample(s) to the area laboratory for specification testing. Use the results of this testing as the reference for the next heavy hydrocarbon test (provided the test results from the area laboratory are satisfactory).

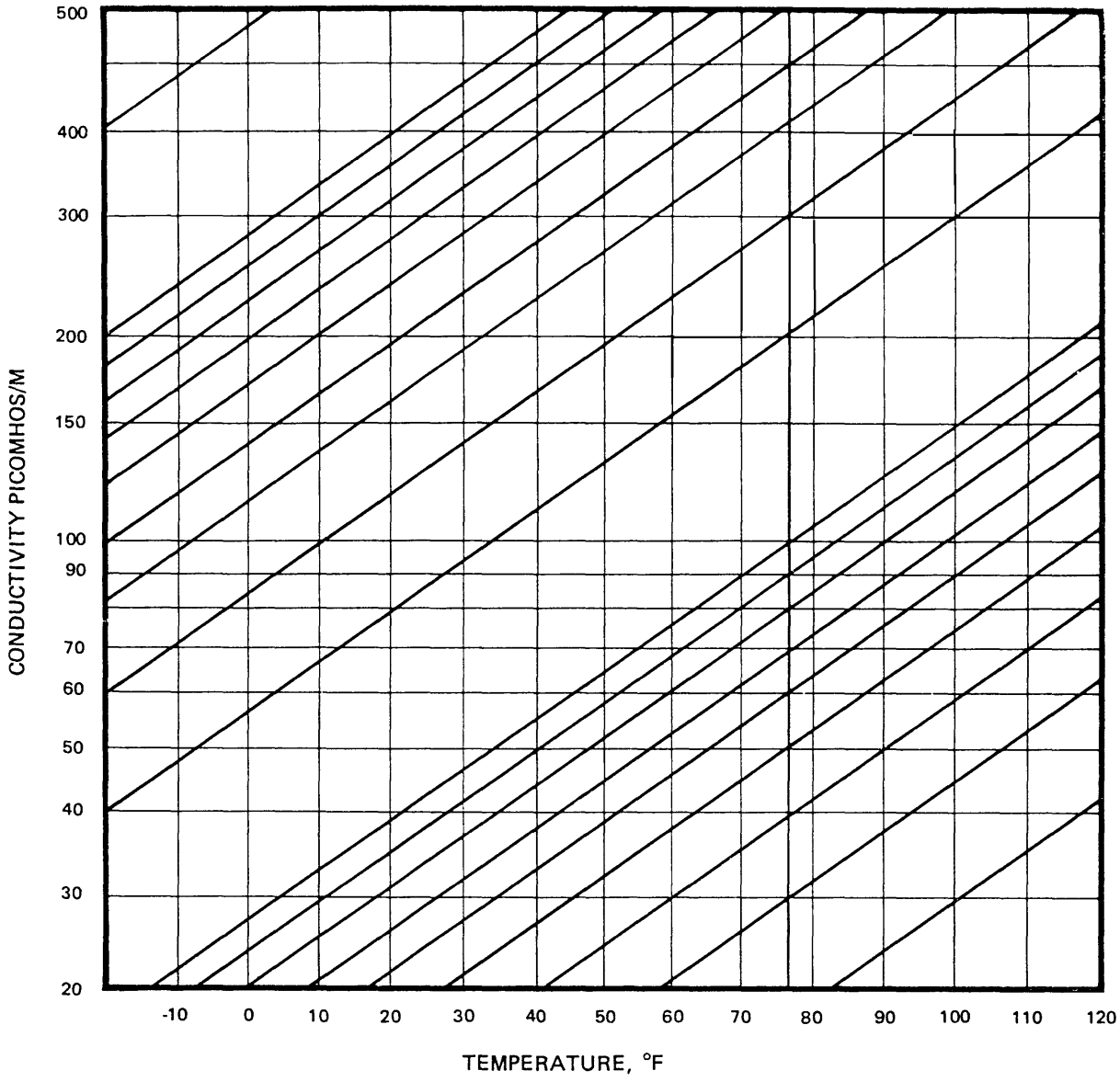
b. Every 45 days take an all-level one-quart and one (one-gallon) sample from one drum selected at random from each batch/lot. Perform a heavy hydrocarbon test on the one-quart sample(s) using the RETAIN from the previous test and forward the one-gallon sample(s) to the area laboratory for specification testing.

c. Prior to issuing AVGAS from a drum batch, five drums from the batch will be randomly inspected for water, sediment, and any other indication of contamination. Visual inspection will be performed by shining an explosion-proof flashlight into the bung hole. If the results are satisfactory, the batch requires no further visual inspection before issue. However, if any of the drums from a batch are contaminated, those drums will not be used and 100 percent visual inspection is required on the remaining drums before they can be used.

d. When unsatisfactory drums are found, report the number of drums rejected, the batch number, and a description of the contamination to DET 3, WR-ALC/AFTH. Likewise, provide the information requested in Paragraph 1.7 of this technical order when drummed AVGAS fails a visual inspection.

e. AVGAS issued from drums to refueling units or directly to aircraft must pass through a filter separator. This may be accomplished by using a PMU-27, another refueler, or any other type equipment that may contain a filter separator.

Table 5-4. Conductivity vs Temperature



EXAMPLE

Conductivity of sample reads 270 at 70°F. If this sample is cooled to 40°F the resultant conductivity would be 170.

Table 5-5. Temperature Conversion

C = (F – 32) x 5/9 (or 0.55)			F = C x 9/5 (or 1.8) + 32		
°F	°C	°F	°C	°F	°C
–40	–40	180	82.2	400	204.4
–35	–37.2	185	85	405	207.2
–30	–34.4	190	87.8	410	210
–25	–31.6	195	90.5	415	212.8
–20	–28.9	200	93.3	420	215.5
–15	–26.1	205	96.1	425	218.3
–10	–23.3	210	98.9	430	221.1
–5	–20.5	212	100	435	223.9
0	–17.78	215	101.6	440	226.6
5	–15	220	104.4	445	229.4
10	–12.2	225	107.2	450	232.2
15	–9.4	230	110	455	235
20	–6.6	235	112.8	460	237.8
25	–3.9	240	115.5	465	240.5
30	–1.1	245	118.3	470	243.3
32	0	250	121.1	475	246.1
35	1.6	255	123.9	480	248.1
40	4.4	260	126.6	485	251.6
45	7.2	265	129.4	490	254.4
50	10	270	132.2	495	257.2
55	12.8	275	135	500	260
60	15.5	280	137.8	550	287.8
65	18.3	285	140.5	600	315.5
70	21.1	290	143.3	650	343.3
75	23.9	295	146.1	700	371.1
80	26.6	300	148.9	750	398.9
85	29.4	305	151.6	800	426.6
90	32.2	310	154.4	850	454.4
95	35	315	157.2	900	482.2
100	37.8	320	160	950	510
105	40.5	325	162.8	1000	537.8
110	43.3	330	165.5	1100	593.3
115	46.1	335	168.3	1200	648.9
120	48.9	340	171.1	1300	704.4
125	51.6	345	173.9	1400	760
130	54.4	350	176.6	1500	815.5
135	57.2	355	179.4	1600	871.1
140	60	360	182.2	1700	926.6
145	62.8	365	185	1800	982.2

Table 5-5. Temperature Conversion - Continued

C = (F – 32) x 5/9 (or 0.55)		F = C x 9/5 (or 1.8) + 32			
°F	°C	°F	°C	°F	°C
150	65.5	370	187.8	1900	1037.8
155	68.3	375	190.5	2000	1093.3
160	71.1	380	193.3		
165	73.9	385	196.1		
170	76.6	390	198.9		
175	79.4	395	201.6		

Table 5-6. Secure Fuel Test Limits

	JP-5		Jet A		Jet A-1		JP-8	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
Gravity API 60°F (51°C)	36.0	48.0	37.0	51.0	37.0	51.0	37.0	51.0
Weight lbs/gal	6.6	7.0	6.5	7.0	6.5	7.0	6.5	7.0
Distillation °F (°C) 10% 20% 50% 90%	 — Report Report Report	 400 (205°C) — — —	 — — — —	 400 (205°C) — — —	 — — — —	 400 (205°C) — — —	 — Report Report Report	 400 (205°C) — — —
End Point	—	572 (300°C)	—	572 (300°C)	—	572 (300°C)	—	572 (300°C)
Freezing Point °F (°C)	—	–51 (–46°C)	—	–40 (–40°C)	—	–53 (–47°C)	—	–53 (–47°C)
Flash Point °F (°C)	140 (60°C)	—	100 (38°C)	—	100 (38°C)	—	100 (38°C)	—
Sediment (mg/gal)	—	2.0	—	2.0	—	2.0	—	2.0
Conductivity pS/m	Report	—	Report	—	Report	—	50	700
Corrosion	—	1	—	1	—	1	—	1
Water Reaction	—	lb	—	lb	—	lb	—	lb
Existent Gum (mg/100ml)	—	7.0	—	7.0	—	7.0	—	7.0
FSII % VOL	0.07	0.20	—	—	—	—	0.07	0.20
Acid Number, mg KOH/gm	—	0.015	—	0.10	—	0.10	—	0.015
Thermal Stability, change in pressure drop mm Hg heater tube deposit, visual rating[1]	—	25 < 3	—	25 < 3	—	25 < 3	—	25 < 3

Table 5-6. Secure Fuel Test Limits - Continued

	JP-5		Jet A		Jet A-1		JP-8	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
Ball-On-Cylinder Lubricity Evaluator (BOCLE)		Report only		Report only		Report only		Report only
Water – Fuel must be clear and free of water on visual examination. Check water content of fuel with AEL or Aqua-Glo water detector kit, if available. Sample will be taken downstream of filter separator. Water content shall not exceed 10 ppm by this method.								
[1]NOTE: If complete testing cannot be performed at a local base lab, or if insufficient time exists for the sample to be forwarded to an Air Force area laboratory, then local commercial testing will be performed. The cognizant DESC Region quality manager will be contacted to arrange for required testing.								

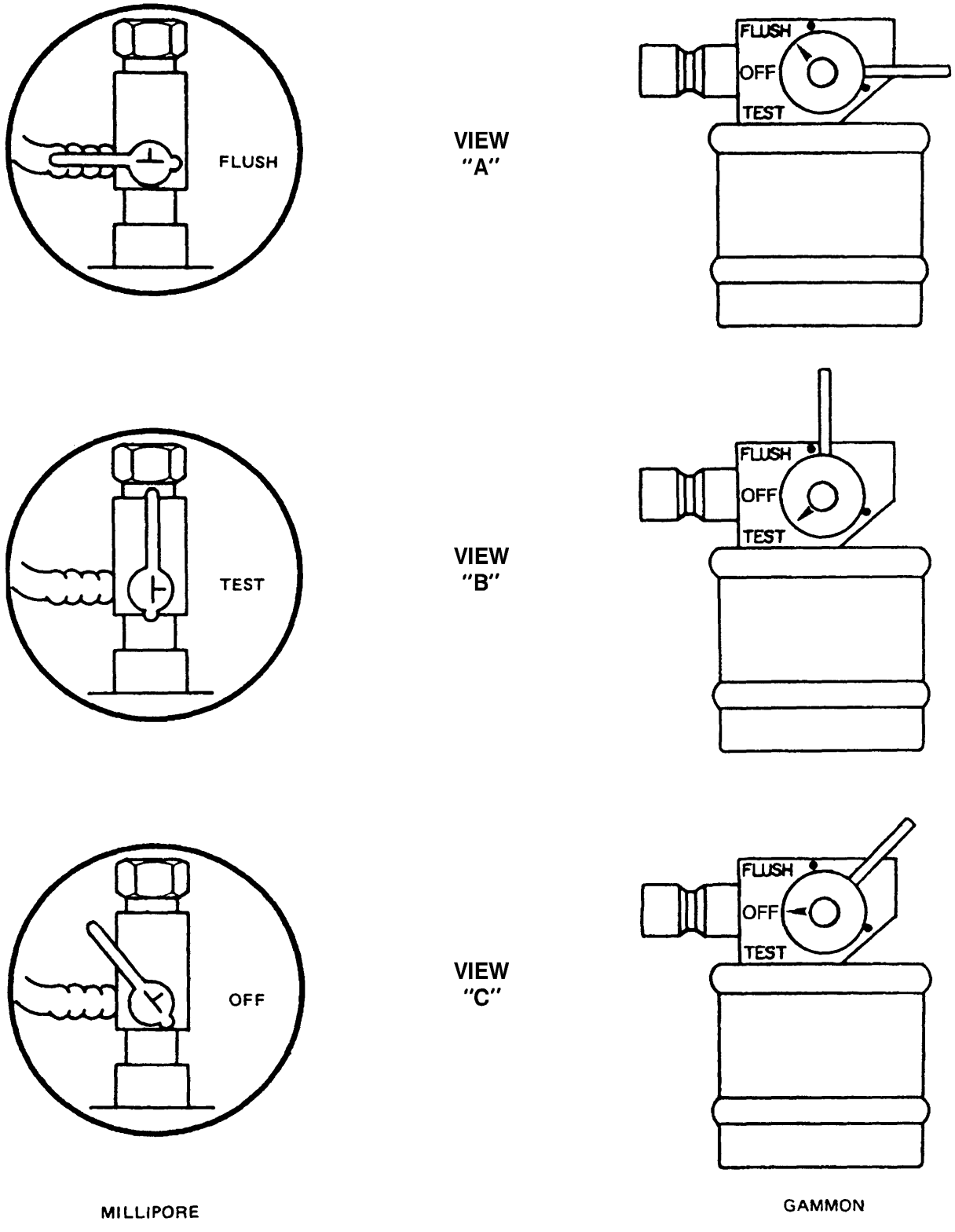


Figure 5-2. 3-Way Valves In-Line Samplers

DISCONNECT BASE OF IN-LINE SAMPLER AND DRILL 1/8 INCH DIAMETER HOLE APPROXIMATELY 1/8 INCH DEEP, HALFWAY DOWN THE SLOPING INNER FACE. THREAD 10 THROUGH 25 GAUGE BARE STRANDED FLEXIBLE WIRE, STAINLESS STEEL, COPPER OR IRON, THROUGH THE HOSE AND BASE OF SAMPLER. EXTEND WIRE 6 INCHES BEYOND END OF HOSE. SOLDER END OF GROUND WIRE INTO THE HOLE DRILLED INTO THE INNER FACE AND SOLDER EXTENDED END OF WIRE TO PREVENT FRAYING.

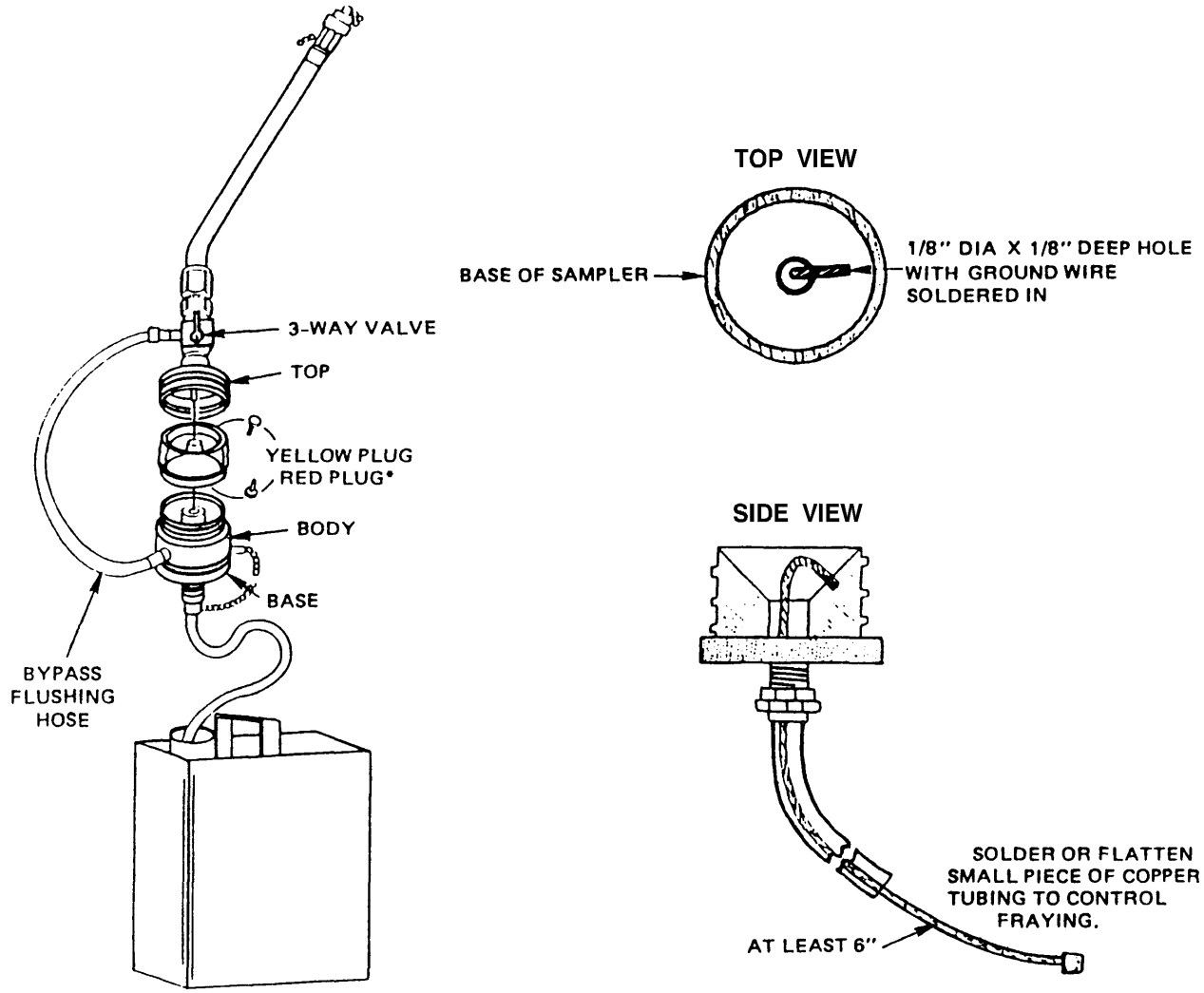


Figure 5-3. Bonding Wire for Millipore In-Line Sampler

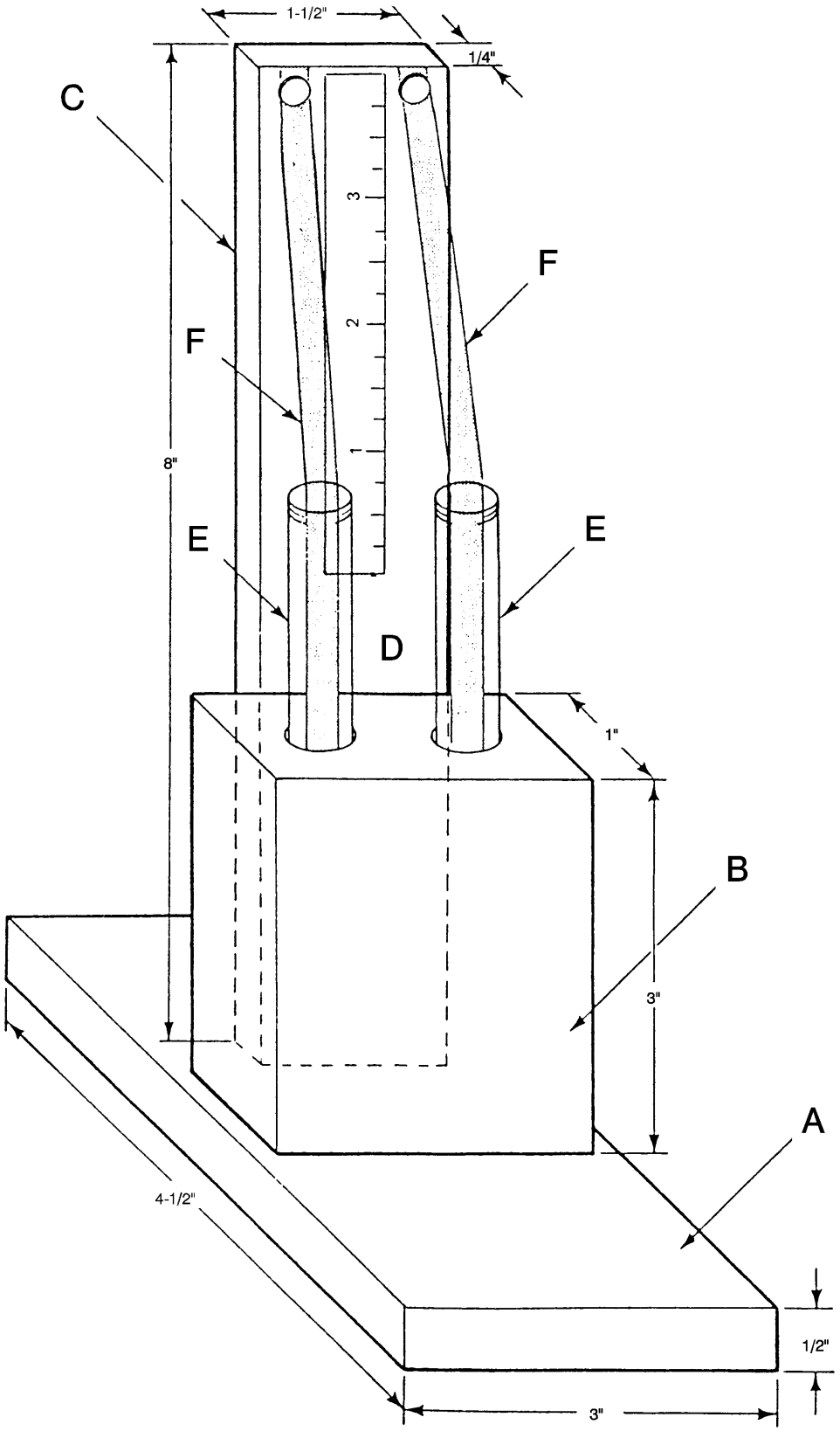


Figure 5-4. Holder Chromatography Strip (Sheet 1 of 2)

LEGEND

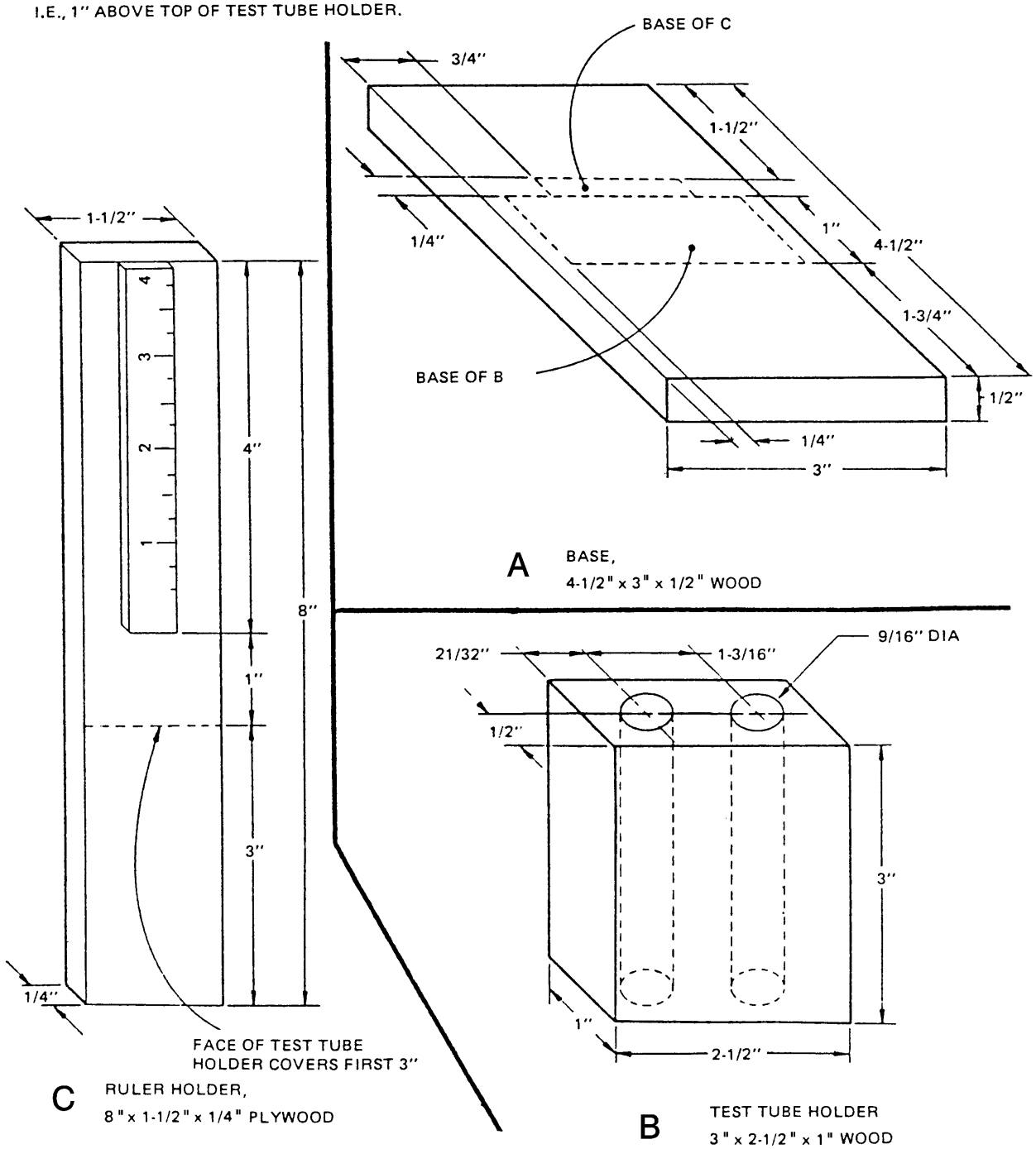
A. Base ½ x 3 x 4½ inches Wood
B. Test Tube Holder 3 x 2½ inches Wood
C. Ruler Holder ¼ x 1½ x 8 inches Plywood
D. Ruler 4 x 1/8 inch
E. Test Tube 10 ml (2) 4 x ½ inch Dia.
F. Filter Paper (2 strips) 8 x ¼ inch

Figure 5-4. Holder Chromatography Strip (Sheet 2)

THE MAJOR CONSTRUCTION OF THE CHROMATOGRAPHY STRIP HOLDER CONSISTS OF THE 3 WOODEN COMPONENTS ILLUSTRATED BELOW.

BASE OF RULER WILL START AT TOPS OF TEST TUBES, I.E., 1" ABOVE TOP OF TEST TUBE HOLDER.

PARTS B & C WILL BE NAILED TO PART A AS ILLUSTRATED.



PARTS D THROUGH F WILL BE ATTACHED AS SHOWN IN FIGURE 5-4. TOPS OF FILTER PAPER STRIPS WILL BE FASTENED TO C BY THUMBTACKS THE BOTTOMS OF THE FILTERS PAPER STRIPS SHOULD BE WEIGHTED WITH PAPER CLIPS BEFORE BEING SUBMERGED INTO THE REFERENCE AND TEST FUELS.

3" x 9/16" DIAMETER HOLES WILL BE DRILLED IN POSITIONS INDICATED BY CIRCLES AND DASHED LINES.

Figure 5-5. Holder Chromatography Strip Wood Components

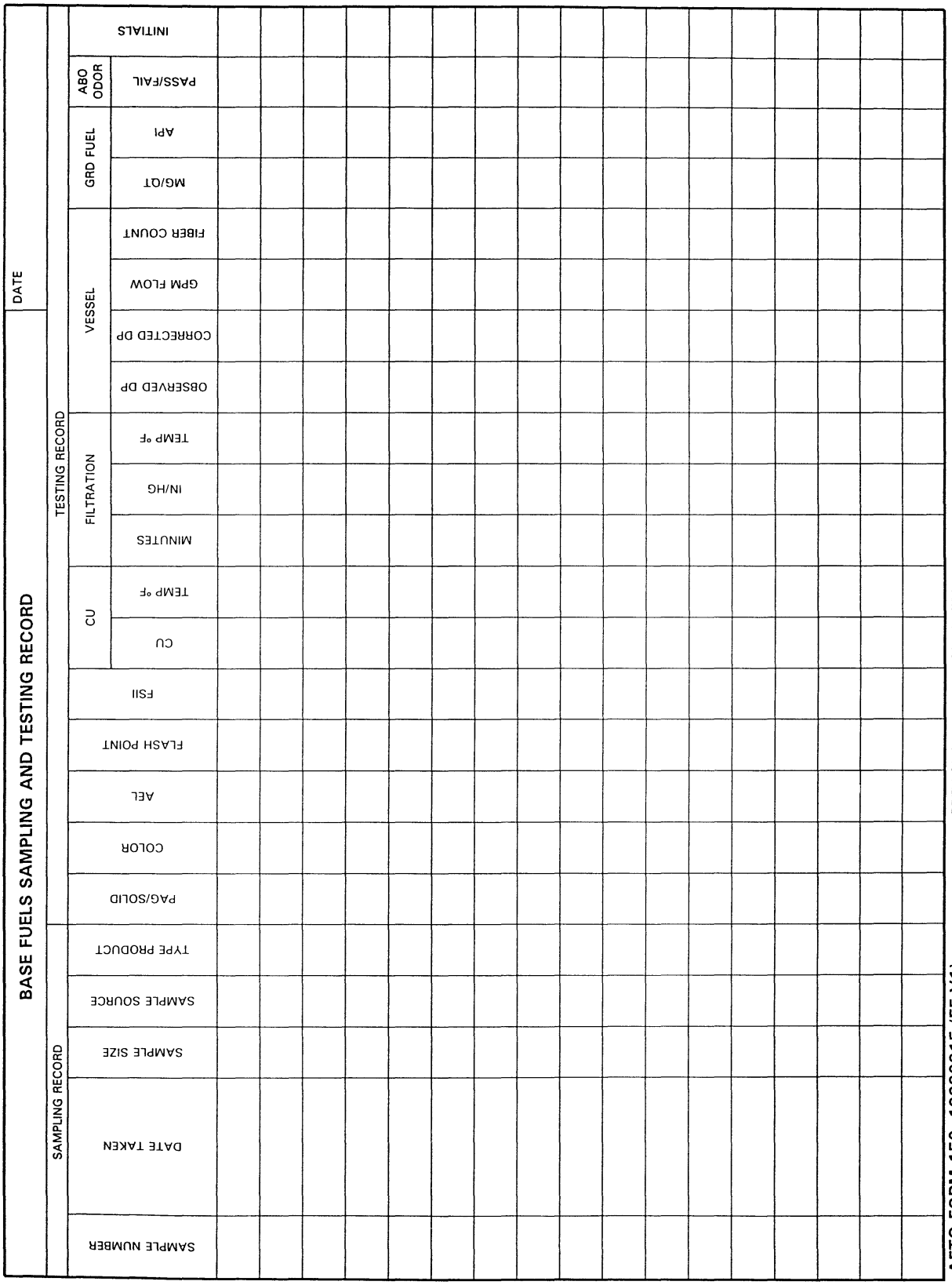


Figure 5-6. Base Fuels Laboratory Test Data Record (Sheet 1 of 2)

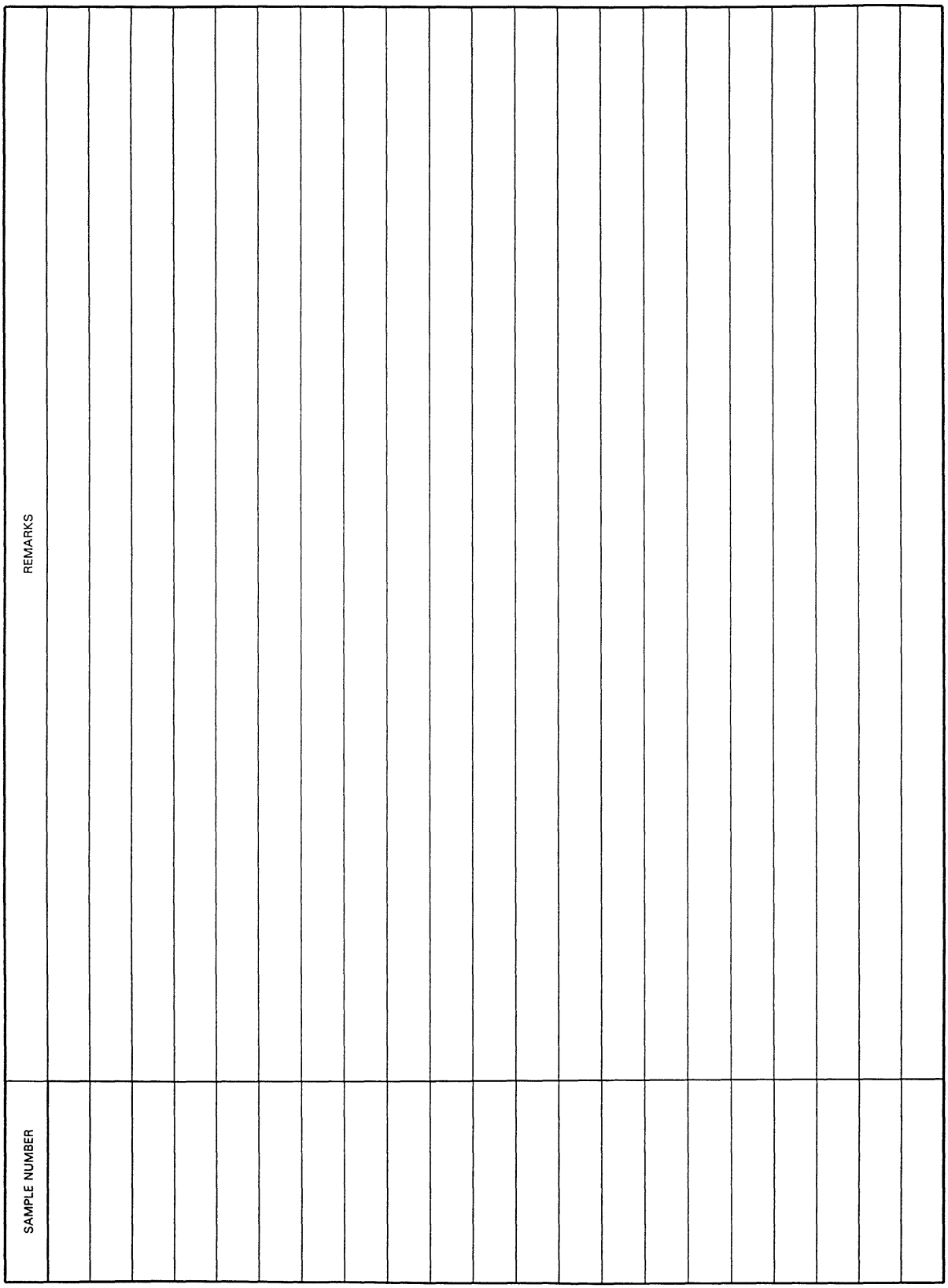


Figure 5-6. Base Fuels Laboratory Test Data Record (Sheet 2)

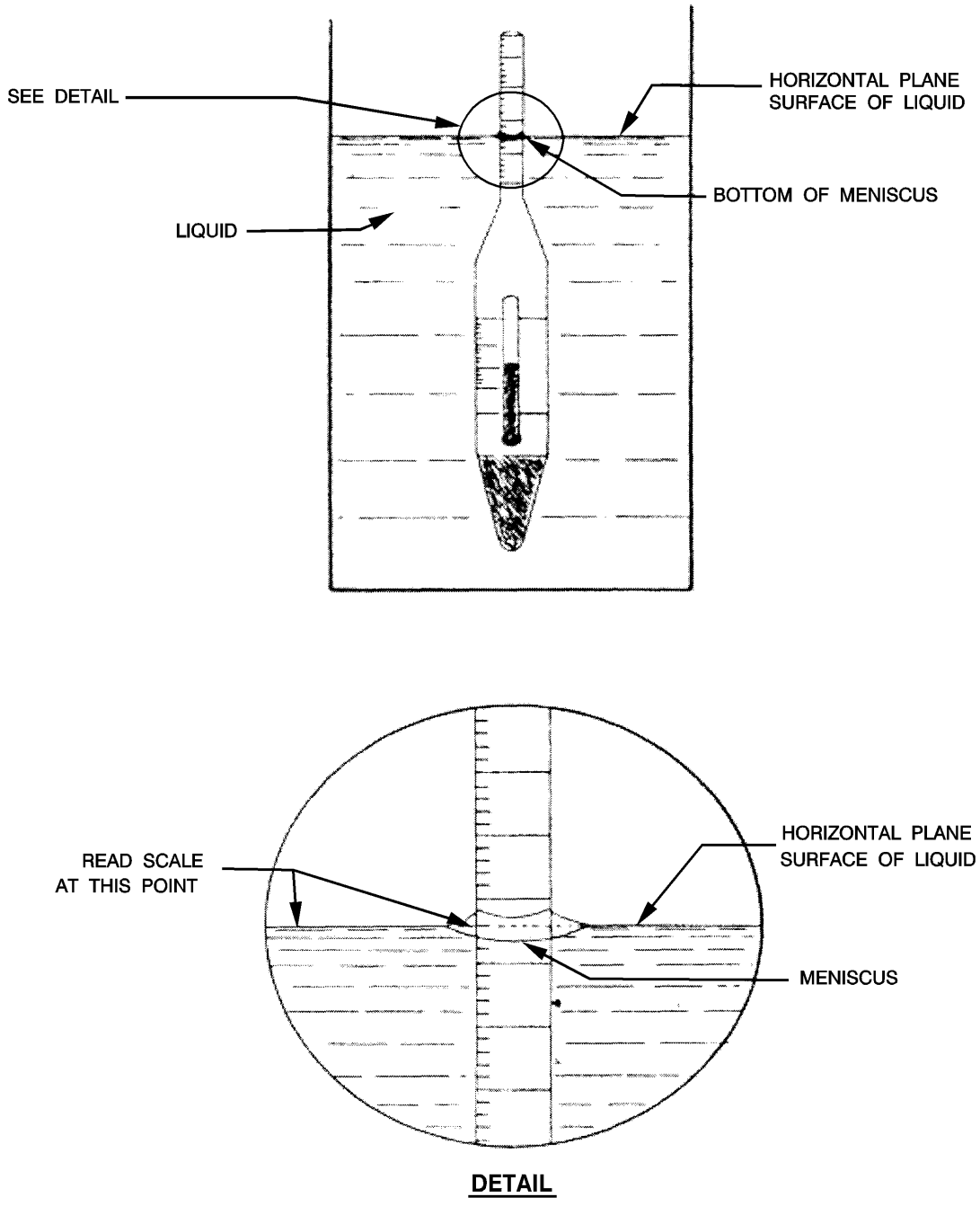


Figure 5-7. Hydrometer Scale Reading for Transparent Liquids

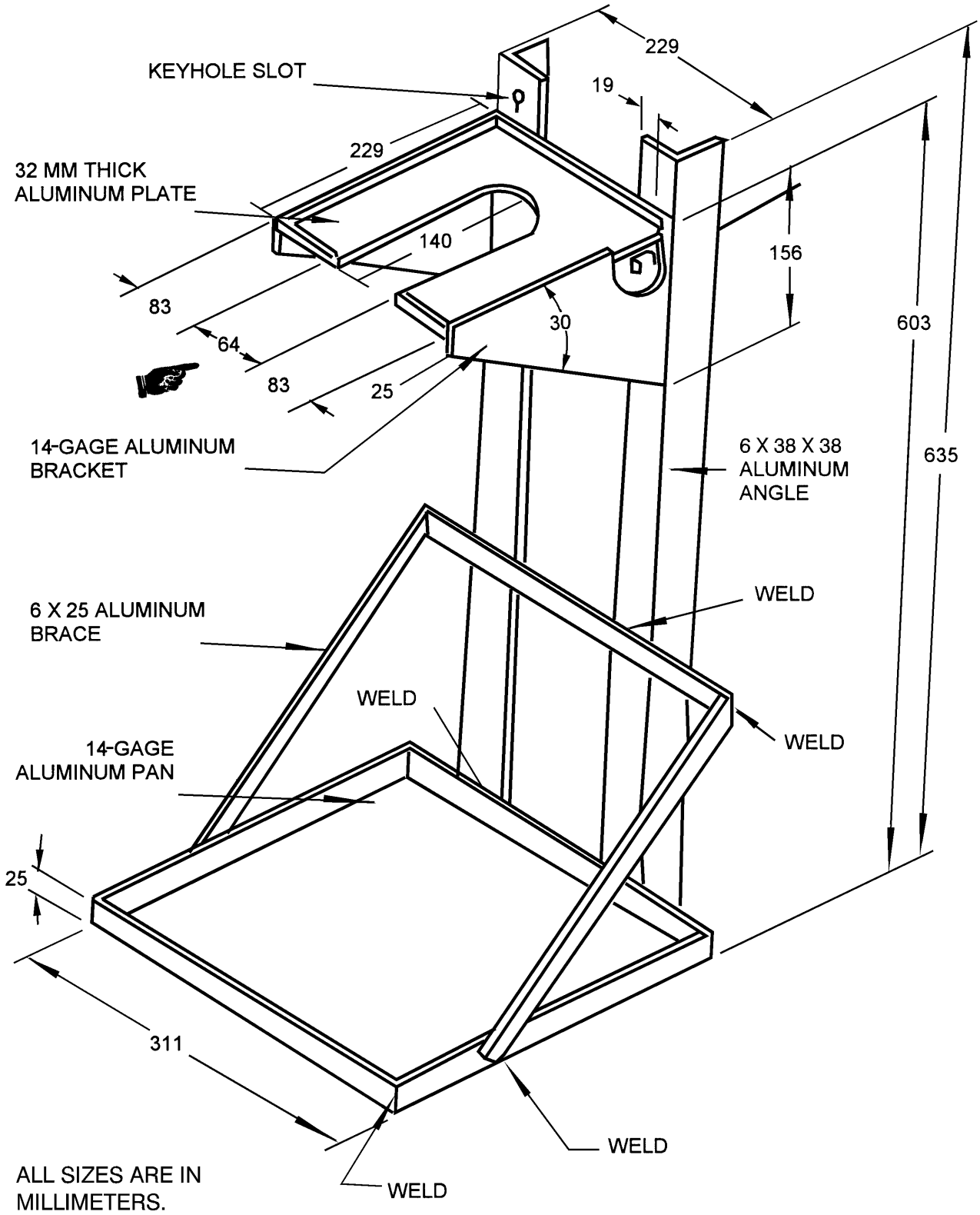
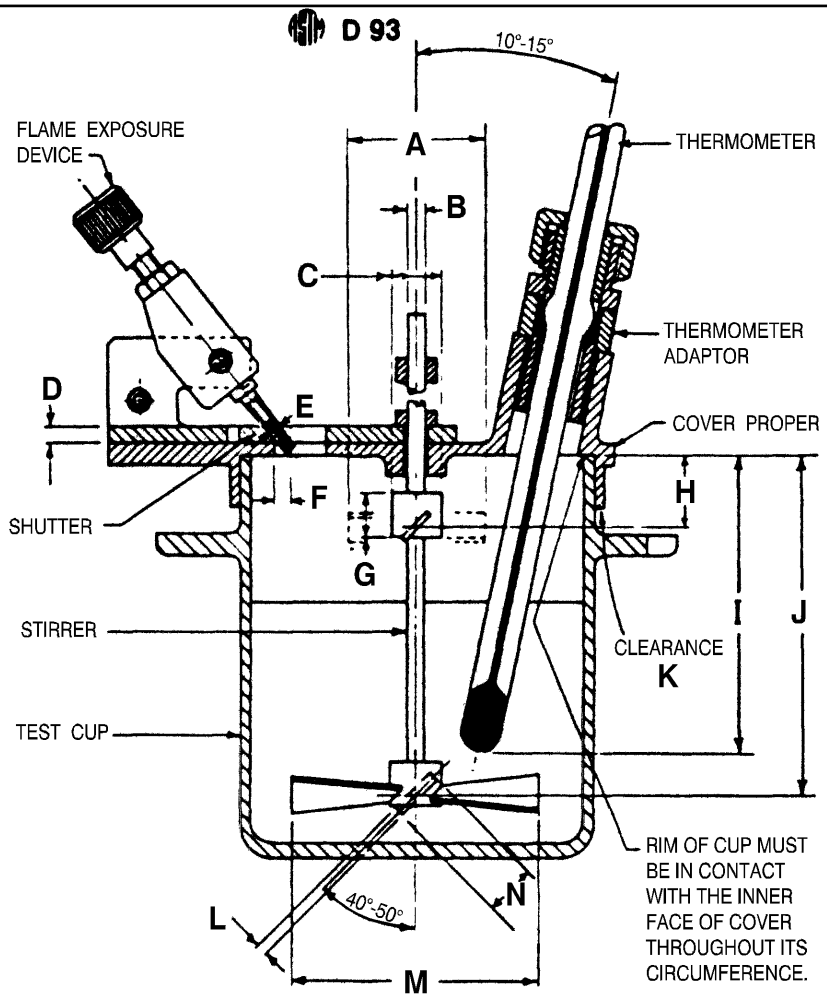


Figure 5-8. Bottle Method Stand



	mm		in.	
	MIN	MAX	MIN	MAX
A	18.3	19.8	0.72	0.78
B	2.38	3.18	0.094	0.125
C	7.6	8.4	0.30	0.33
D	2.0	2.8	0.08	0.11
E	0.69	0.79	0.027	0.031
F	2.0	2.8	0.08	0.11
G	6.4	10.4	0.25	0.41
H	9.6	11.2	0.38	0.44
I*	43.0	46.0	1.69	1.81
J	50.0	51.6	1.97	2.03
K		0.36		0.014
L	1.22	2.06	0.048	0.08
M	31.8	44.4	1.25	1.75
N	7.6	8.4	0.30	0.33

* Includes tolerance for length of thermometer given in Specification E-1.

Figure 5-9. Pensky-Martens Assembly Standard

CHAPTER 6
GROUND FUELS

6.1 GENERAL.

This chapter provides guidance for the quality control of ground fuels to ensure proper operation of equipment and compliance with environmental control. Ground fuels consist of the following products and respective specifications:

ASTM D 4814	– Automotive Gasoline
ASTM D 975	– Diesel Fuel (DL-1, DL-2, LSDF)
ASTM D 396	– Fuel Oil
A-A-52557	– Fuel Oil, Diesel
A-A-59693	– Biodiesel

a. Ground fuel products used at overseas locations will be refined and identified by their own unique commercial specifications. Further identification may be available if these products conform to NATO standards.

b. Contamination – High particulate and/or water content can lead to diesel equipment contamination, poor performance, and shutdown. To minimize mission essential equipment failures, storage tanks and mobile tanks shall be drained of water daily or prior to use. To preclude high particulate and/or water, spin-on filtration (10-micron) shall be installed on service station island pumps. Filtration kits are available for ground fuel distribution vehicles. Activities that continuously experience high particulate and/or water problems with C-300/301 equipment should consider installing the filtration kits when unit funding becomes available. Contact DET 3, WR-ALC/AFTH for information associated with filtration kits for ground fuel distribution vehicles.

6.2 MOTOR GASOLINE (MOGAS).

ASTM D 4814, the Standard Specification for Automotive Spark-Ignition Engine Fuel, describes various characteristics of automotive fuels for use over a wide range of operating conditions. Anti-knock and volatility define the physical characteristics of greatest interest relating to the fuels suitability for the particular condition of use.

6.2.1 MOGAS Receipts.

a. Visual inspection will be required for both identification and quantity. If there is evidence that deliveries are not in conformance with the contract, obtain assistance from DET 3, WR-ALC/AFTH.

b. In conjunction with the visual inspection check the delivery documents to verify the required oxygenate has been injected into the product, if required.

(1) Verify the grade.

(2) Take a one-gallon and a one-quart sample during discharge from the off-loading header at a point as close as possible to the TT/TC. Take the samples using an in-line sampler in the bypass position or a straight Teflon sampling hose equipped with an internal bonding wire. Take the samples approximately one minute after line fill has been displaced and make a visual assessment on the quart sample. The product shall be clear and bright and free of solids and water. If the sample fails, contact DET 3, WR-ALC/AFTH and MAJCOM Fuels Office. If unable to obtain samples using the in-line sampler from the header, take the samples from the top of the delivery trailer using a weighted bottle sampler. The one-gallon sample will be held as a retain sample in the event the fuel requires further testing by the area lab. The retain sample will be returned to bulk once the product has been consumed, or after the next receipt, whichever occurs first.

(3) Deliveries of oxygenated product will be randomly sampled during the period required. Take a one-gallon representative sample from the delivery conveyance or discharge line after displacement. Forward the sample to OL DET 3, WR-ALC/AFTLA, Wright-Patterson AFB, OH 45433-7632 for oxygenate testing.

(4) When experiencing poor engine performance or there is a need to verify octane rating, forward a representative sample to OL DET 3, WR-ALC/AFTLA.

6.3 GASOHOL.

6.3.1 Gasohol Receipts.

a. Take a one-gallon and a one-quart sample during discharge from the off-loading header at a point as close as possible to the TT/TC. Take the samples using an in-line sampler in the bypass position or a straight Teflon sampling hose equipped with an internal bonding wire. Take the samples approximately one minute after line fill has been displaced and make a visual assessment on the quart sample. The product shall be clear and bright and free of solids and water. If the sample fails, contact DET 3, WR-ALC/AFTH and the MAJCOM Fuels Office. If unable to obtain samples using the in-line sampler from the header, take the samples from the top of the delivery trailer using a weighted bottle sampler. The one-gallon sample will be held as a

retain sample in the event the fuel requires further testing by the area lab. The retain sample will be returned to bulk once the product is consumed, or after the next receipt, whichever occurs first. Upon receiving a cargo of gasohol and every 30 days thereafter, base fuels personnel will sample and test the gasohol for alcohol content and to determine if phase separation has occurred.

b. If phase separation is determined at time of delivery, the product is deficient and should not be accepted or off-loaded.

c. If any off-specification condition is suspected, a one-gallon sample shall be sent to servicing area laboratory for analysis.

d. Base Level Test for Percent Ethanol in Gasohol.

(1) Equipment Required – graduated glass-mixing cylinder with stopper, 100-milliliter volume, with one-milliliter graduations, NSN 6640-00-420-6000.

WARNING

Gasohol is volatile, extremely flammable and harmful or fatal if swallowed. Keep away from heat, sparks, or open flame. Keep container closed and perform testing in a well-ventilated area. Avoid skin or eye contact and prolonged or repeated breathing of vapor. If swallowed, do not induce vomiting. Call a physician immediately.

(2) Test Procedures.

(a) Fill the graduated cylinder to the 10 ml mark with tap water.

(b) Add 90 mls of the gasohol to be tested.

(c) Add one drop of food dye, NSN 8950-00-616-4513.

(d) Shake the mixture. Let stand for two minutes. The dye will only enter into the alcohol/water mixture and the gasohol will remain colorless.

(e) The separation should show 80 – 85 ml gasoline floating on 15 – 20 ml of colored alcohol/water.

(3) Normal readings derived from the above test will show 15 – 17 mls of an alcohol/water phase. Too high a reading (25 ml of alcohol/water) could indicate either a non-homogeneous (stratified-poorly mixed) product or phase separation due to the presence of water. If the product does not pass, retest immediately. If the retest also fails, forward a one-gallon sample to the servicing area laboratory.

6.4 E85 ETHANOL.

Physical Properties – ethanol is a flammable, colorless liquid with a faint alcohol odor. The color of ethanol fuel blends depends on the color of the gasoline in the blend. Alcohols are more corrosive than gasoline because they are electrically conductive and may contain corrosive impurities. Alcohols may degrade materials that are commonly used with gasoline or diesel fuel.

6.5 SAMPLING EQUIPMENT.

Steel containers with epoxy lining, or glass containers will be used for sampling and testing of E85.

6.6 E85 FUELING SYSTEMS.

The worst enemy of alcohol fuel is water. Water is usually present in storage tanks and is always present in the air. Since E85 cannot tolerate more than 1 percent by volume of water before alcohol separation occurs, it is absolutely essential to deliver a clean, water-free product to the vehicle. In many cases, existing gasoline, diesel, or other hydrocarbon fueling systems may be used to store and dispense fuel ethanol. Tanks selected for E85 use will be inspected, cleaned, and certified by the Liquid Fuels Maintenance Foreman or MAJCOM Fuels Engineer.

a. Initial Fill Procedures (All Tanks) – fill the tank with base-tested E85 according to Paragraph 6.7. For the initial fill allow 48 hours settling time.

b. Displace twice the volume of the dispensing line prior to obtaining sample. Collect the sample in a clear wide mouth container and visually inspect for particles and water.

c. If the sample appears clean, return the sample to the tank. If the sample has particulate contamination, filter by any means available, and return to tank. If the sample fails visual examination, flush dispensing line until samples are clear and free of visible particles.

d. Take two one-gallon samples. Test one of the one-gallon samples for ethanol content according to Paragraph 6.7, Step b, and save as a retain sample until results are received from the area lab. Send the second one-gallon sample to the servicing area laboratory for analysis. Ensure the AFTO Form 475 identifies the sample as E85 Ethanol, and reference this paragraph in the remarks section.

NOTE

Do not return fuel water mixtures into the tank. Dispose of fuel water mixtures according to local guidelines and regulations.

6.7 E85 RECEIPT OPERATIONS.

a. Prior to off-loading E85, make every effort to take a sample from the delivery unit. Check sample for water, particulate contamination and ethanol content using the procedures outlined in Paragraph 6.7, Step b. If free water is present, the shipment should not be accepted or off-loaded. Normal ethanol concentration readings will show a minimum of 79% for Class 1, 74% for Class 2, and a 70% for Class 3 of E85 blends. If the product is not ON TEST according to receipt paperwork, retest immediately. If the retest confirms the original test result, contact DET 3, WR-ALC/AFTH for guidance.

(1) Take a one-quart sample during discharge from the off-loading header at a point as close as possible to the TT/TC. Take the sample approximately one minute after the line fill has been displaced and make the visual examination. The product shall be free of solids and water and shall be clear and bright. If sample fails visual inspection, terminate off-loading operation and contact DET 3, WR-ALC/AFTH, Wright Patterson AFB, OH, DSN: 785-8070 for guidance. A test of the ethanol concentration will be performed on this sample if it had not been determined prior to off-loading.

(2) Deliveries of E85 will be randomly sampled monthly, (if operations do not support monthly deliveries, a sample will be collected during the next receipt operation), and sent to the area lab for analysis. Take two, one-gallon representative samples from the delivery conveyance or discharge line after displacement. Forward one of the one-gallon samples to the area laboratory and keep the other as a retain sample. The retain sample will be returned to bulk once satisfactory results are obtained from the area lab.

b. Base Level Test for Ethanol Percentage in E85 – base fuels laboratory personnel will sample and test E85 for ethanol content according to the following procedures:

(1) Equipment Required – graduated glass mixing cylinder with stopper, 100 milliliter volume, with one milliliter graduations, NSN 6640-00-420-6000, 50-ml volumetric pipette.

WARNING

E85 is volatile, extremely flammable and is harmful or fatal if swallowed. Keep away from heat, sparks, or open flame. Keep E85 containers closed and perform testing in a well-ventilated area. Avoid skin or eye contact and prolonged or repeated breathing of vapor. If swallowed, do not induce vomiting. Call a physician immediately.

(2) Ethanol Content Test Procedures.

(a) Using a suction bulb and the 50-ml pipette, fill the 100-ml graduated cylinder to the 50-ml mark with E85.

(b) Add 50-ml of tap water to the fuel in the cylinder.

(c) Shake the mixture vigorously for 15 seconds. Loosen the stopper to relieve pressure.

(d) Reinsert the stopper and let the mixture stand, away from heat sources and out of sunlight for 15 minutes or until complete separation has occurred. (If separation of the two layers is not complete within 10 minutes, tap the side of the cylinder to encourage complete separation, and wait an additional 5 minutes.)

(e) Record the amount in ml from the bottom of the meniscus of the upper hydrocarbon layer to the bottom of the meniscus at the top of the upper hydrocarbon layer.

(f) Calculate the ethanol concentration by subtracting 98.69 from the total of 1.97 multiplied by the volume of the upper layer in ml % ethanol = 98.69 – (1.97 x volume of upper layer in ml). (This test may have errors in ethanol content by up to 5 percent.)

NOTE

The ASTM D 5798 covers fuel blends for different seasons and geographical areas. These specifications represent the minimum commercial standards. The amount of alcohol in the fuel ethanol blend depends on the geographical fuel-marketing region and the season. In cold weather, more gasoline is added to the blend to avoid starting problems. A minimum of 70% by volume of alcohol is permitted in the winter blend.

c. If separation occurs in the storage tank, this indicates that:

(1) The system was not prepared properly as outlined in Paragraph 6.6.

(2) Proper blending of gasoline and ethanol was not accomplished.

(3) There is a leak in the underground storage tank or water is getting in the tank by some other means.

d. Remove the ethanol/water (bottom) phase by stripping pump. Dispose of the alcohol/water product through Defense Reutilization and Marketing Office or as directed by the Base Bio-Environmental Engineer. Before reordering E85, have the underground tank tested for leaks. If the tank leak check is satisfactory, clean the tanks again before ordering and dispensing E85.

6.8 E85 OPERATIONAL TANK SAMPLING.

After the service station begins normal operation, the following samples will need to be taken:

a. Every 7 days – obtain a sample of fuel from the dispensing hose into a quart sized clear glass container. This represents the fuel stored in the hose between the filter and the nozzle. If particulates are found in the sample, the hose may have started to degrade. Do not dispense product until the source of contamination has been identified and corrected.

b. Every 30 days – take a visual sample of the fuel in the tank according to procedures in Paragraph 6.7, Step a (1), and perform the ethanol content test according to Paragraph 6.7, Step b.

c. Quarterly – displace twice the volume of the dispensing line. Collect a clean sample into a one-gallon sample can. Send the sample to the servicing area laboratory.

6.9 PROPANE MOTOR FUEL.

Receipt – propane is delivered by commercial truck. The truck driver must have a certificate of compliance indicating that the propane conforms to the Gas Producers Association (GPA), Grade HD-5. An authorized government representative, or the contractor's representative must have signed the certificate.

6.10 MOGAS AND DIESEL FUEL TANK CLEANING.

a. A discharge line or an all-level sample will be taken annually and analyzed by the bottle method for solids as outlined in Chapter 5 of this publication. Sample size is one liter. Tanks will be inspected and cleaned when the solids content exceeds the following limits:

MOGAS = 8 mg/L

DIESEL/BIODIESEL = 16 mg/L

Contact DET 3, WR-ALC/AFTH for additional guidance if level exceeds the above prescribed limits.

b. Many tanks used for MOGAS and diesel fuel cannot be entered for inspection of cleaning due to the lack of a manhole. When excessive contamination is detected in these types of tanks, the tanks should be modified to permit physical entry.

6.11 DORMANT STORAGE TESTING.

Table 6-1 provides minimum sampling requirements for dormant products. The product is considered dormant if at least two-thirds of the tank content had not been discharged and replenished by product receipt during the sample frequency specified.

6.12 DIESEL FUEL.

ASTM D 975, the Standard Specification for Diesel Fuel Oils, is the commercial specification for this product.

a. Lubricity – the Scuff Load BOCLE (SLBOCLE), ASTM D 6078, and High-Frequency Reciprocating Rig (HFRR), ASTM D 6079, are the two methods for evaluating the lubricating property of diesel fuel.

(1) Fuels having a SLBOCLE lubricity value below 2,000g might not prevent excessive wear in injection equipment while fuels above 3,100g should provide sufficient lubricity in all cases.

(2) If HFFR at 60°C (140°F) is used, fuels with values above 600 microns might not prevent excessive wear, while fuels with values below 450 microns should provide sufficient lubricity in all cases.

(3) When a lubricity deficiency is confirmed by laboratory analysis a field-expedient method of improving lubricity is by blending, MIL-PRF-25017, corrosion inhibitor/lubricity improver into the diesel fuel. The blend ratio should be 250 ppm (one quart/1,000 gals). Contact DET 3, WR-ALC/AFTH at DSN: 785-8070 for guidance.

b. Viscosity – the minimum viscosity at 40°C (104°F) is 1.3 mm2/S. Rotary injection pumps are not capable of reliable operation on viscosities less than 1.3 mm2/S @ 104°F. There are no additives to improve low viscosity. Low viscosity is common on winterized DL-1 because of the practice of blending with kerosene to depress the cloud point.

6.12.1 Diesel Fuel Receipts.

NOTE

Steps a – d applies to DESC Customer Organized Group (COG) 6 locations only.

a. Take a one-quart bottle sample and a one-gallon RETAIN sample during discharge from the off-loading header at a point as close as possible to the TT/TC on each receipt. Take the samples using an in-line sampler in the bypass position or a straight Teflon sampling hose equipped with an internal bonding wire. Take the samples approximately one minute after line fill has been displaced and make a visual assessment of the one-quart sample. The product shall be free of undissolved water, sediment, and suspended matter.

b. If the sample fails, resample and perform the test a second time. If the second sample fails, contact DET 3, WR-ALC/AFTH and MAJCOM Fuels Office.

c. If the sample passes the visual test, continue to off-load the product and perform a flash point test and an API gravity in the base laboratory. Flash point minimums are 126°F (52°C) for LS2 and 100°F (38°C) for LS1. Typical API gravity range, (corrected to 60°F) for diesel is between 30 and 42. If unable to obtain samples using the in-line sampler from the header, take the samples from the top of the delivery trailer using a weighted bottle. The RETAIN sample will be returned to bulk once the product is consumed, or after the next receipt, whichever occurs first. It is important that this RETAIN sample is correctly marked to identify the date and exact source of the sample to include conveyance truck and trailer number.

d. The COG locations that have experienced problems with diesel fuel waxing/gelling during cold weather months shall refer to Paragraph 6.13, Cold Weather Operations.

NOTE

Steps e – h applies to all other DESC COG locations (EXCLUDING COG 6).

e. Take a one-quart bottle and two one-gallon samples during discharge from the off-loading header as close as possible to the TC/TT on each receipt. Take the samples approximately one minute after line fill has been displaced and make a visual assessment of the one-quart sample. The product shall be visually free of visible water, sediment, and suspended matter. Mark one of the one-gallon samples as TEST and the other as RETAIN.

f. Perform the following tests from the one-gallon TEST sample in the base laboratory. Test for cloud point (only required at bases which have experienced problems with diesel fuel waxing or GELLING during cold weather months), total solids, flash point, and API gravity. Filter one liter of product using a 0.8 micron, 47 mm, nylon filter without flow reducer ring. The maximum limit for particulates is 10 mg/L. EXCEPTION: some CONUS and overseas bases/activities/forward deployed locations will follow local contract specifications. Flash point shall be 126°F (52°C) or greater, corrected (refer to Paragraph 5.14, Flash Point), for DF-2, DL-2, LS-2, or AG-2 and 100°F (38°C) minimum for DF-1, DL-1, LS-1, or AG-1. Typical API gravity range (corrected to 60°F) for diesel is between 30 and 42.

g. If the TEST sample passes, return remainder of TEST sample to inventory.

h. If the first analysis fails any property, perform a retest. In the event of a second failure, notify DET 3, WR-ALC/AFTH.

6.12.2 Periodic Sampling and Testing. Every 90 days a sample will be taken from the base service station dispensing nozzle representative of the tank contents and analyzed for particulate matter content IAW ASTM Method D-6217 (refer to Paragraph 5.9, Step f (2) for membrane filter preparation). One liter of product will be filtered using the 47 mm, 0.8 micron, nylon filters (two each) without flow reducer ring. The maximum limit for patriculates is 10 mg/L. If the sample exceeds the 10 mg/L limit, resample and retest. In the event of a second failure, notify DET 3, WR-ALC/AFTH.

6.13 COLD WEATHER OPERATIONS.

a. The lower temperature performance of the diesel fuels shall be defined by one of the following two properties: Cloud Point or Cold Filter Plugging Point (CFPP).

b. Diesel fuel contains from six to eight percent wax. This wax is in solution and is an important factor in energy content. At low temperatures, the wax crystallizes and precipitates out of the fuel. The temperature at which this crystallization first begins to take place is known as the cloud point. Wax crystals in the fuel cause filter clogging and other problems, which may result in vehicle/equipment inoperability during winter months.

c. Bases which have experienced problems with diesel fuel waxing or GELLING during winter months should request DESC procure a winter grade of diesel fuel having a cloud point no higher than the lowest expected ambient temperature for the period of time which the fuel will be consumed.

d. The temperature data contained in Table 6-2, along with the cloud point determination, can aid in predicting if the diesel fuel is suitable for use. If winter grade diesel fuel is unavailable, it will be necessary to locally WINTERIZE the fuel by blending kerosene, or other low cloud point sol vents and fuels, with base-level stocks. This win terization must be done before temperatures drop and wax crystallization begins.

e. The cloud point of the diesel fuel on hand for the winter or cold weather season (October to March) must be known or determined for bases that have experienced cold weather problems with diesel fuel or those that anticipate potential problems based upon the information in Table 6-2. In most cases, it will be necessary to test the diesel fuel to determine the cloud point. Obtain the cloud point test apparatus and perform the test every 30 days on all diesel fuel received from October to March. Until the test equipment is operational, send a one-gallon sample from each diesel delivery and every 30 days from a tank to the area laboratory. The test shall also be performed on product in the bulk tank early enough to detect and prevent distribution of problem product that may not be consumed before cold weather arrives. Ensure the product in storage meets the coldest temperatures expected; if the fuel is procurred in October but will not be used until December, the December 10th percentile temperature applies.

f. A procedure, adapted from Test Method D 2500 for base level testing, is provided below:

(1) Safety Precautions – the isopropyl alcohol (2-propanol), NSN 6810-00-855-6160, used in the final cloud point bath is flammable; therefore, perform all testing procedures involving the final bath under an operating exhaust/fume hood.

(2) To reduce foaming and consumption of solid carbon dioxide, lower the isopropyl alcohol temperature prior to preparing the final bath by chilling a suitable quantity of isopropyl alcohol in a metal covered container placed inside of a bucket of crushed ice and calcium chloride (rock salt).

(3) When preparing the final bath slowly add solid carbon dioxide to the bath to reduce foaming. Use eye protection or lower the exhaust fume hood door for protection.

(4) Solid carbon dioxide has a temperature of –80°F (–62°C). Skin contact with dry ice will cause serious low temperature burns. Temperature resistant non-asbestos gloves and apron will be used when handling. Carbon dioxide displaces oxygen, which can cause asphyxiation. Use only in well-ventilated areas.

(5) The bath mixtures commonly used for various temperatures are shown below:

Ice and Water	50°F (10°C)
Crushed Ice and Sodium Chloride Crystals	10°F (–12°C)
Crushed Ice and Calcium Chloride Crystals	–15°F (–26°C)

(6) Remove moisture present in the sample to be tested by filtration through a 1.2-micron membrane filter until the diesel fuel is clear.

(7) Prepare a crushed ice and calcium chloride bath. The container selected should be large enough to permit partial immersion of the jacket and test jar containing the sample.

(8) Pour the sample to the 54 mm level mark in the test jar. Close the jar tightly using the cork carrying the ASTM 5F thermometer. The position of the cork and thermometer should be adjusted so that the cork fits tightly and the thermometer bulb is resting on the bottom of the test jar. See Figure 6-1 for illustration of posi tioning of the thermometer, cork, disk, and jacket inside of bath.

(9) Place the jacket containing the test jar and sample in the crushed ice and calcium chloride bath. Frequently observe the test jar thermometer, while permitting the sample temperature to decrease to at least 25°F above the expected cloud point. Upon attaining the desired test jar temperature transfer the sample to the final bath.

(10) During the test procedures, the disk, gasket, and the inside of the jacket should be clear and dry. Never place the test jar directly into the liquid cooling medium.

(11) Prepare a final bath using chilled isopropyl alcohol and add solid carbon dioxide slowly to prevent foaming.

(12) Place the jacket containing the test jar and sample in the final bath.

(13) At each 2°F (1°C) drop in temperature remove the test jar from the jacket without disturbing the fuel. Inspect for cloud and replace in the jacket. This complete operation shall require no more than three seconds.

(14) When such inspection first reveals a distinct cloudiness or haze in the fuel at the bottom of the test jar, record the temperature from the thermometer as the cloud point. Report and record the cloud point to the nearest whole degree.

(15) If the predicted ambient temperature is lower than the cloud point determined for the diesel fuel, low temperature operational problems will probably occur and fuel blending is recommended.

6.14 BLENDING DIESEL FUEL.

NOTE

BLENDING DIESEL FUEL OPERATIONS ARE ONLY AUTHORIZED AFTER CONSULTATION WITH DET 3, WR-ALC/AFTH AND DESC-BQ.

a. Fluids that can be used to blend with diesel fuel are shown in Table 6-3. All of these fluids have cloud points considerably below that of DL-2 and flash points above 100°F (38°C). See T.O. 42B1-1-1, FUELS FOR USAF PISTON AND TURBINE SUPPORT EQUIPMENT AND ADMINISTRA TIVE VEHICLES.

b. Once the cloud point and expected ambient temperatures are known, blending ratios can be determined from Table 6-4.

c. Blending Procedures – fuel blending consists of adding the proper quantity of blending fluid and mixing thoroughly to assure homogeneity. A thorough mix of the two fluids is essential to effectively lower the cloud point to the desired temperature.

d. Circulation of the tank, and mixing by product issue and return to bulk are two satisfactory methods used to obtain homogeneity. To determine if a satisfactory mix has been obtained, take a top, middle, and bottom sample from the tank and perform cloud point determination on each sample. If results do not indicate a proper mix, further mixing is necessary.

e. Once a satisfactory mix has been accomplished, forward a one-gallon composite sample to DET 3, WR-ALC/AFTLB, Searsport, ME 04974, for cloud point, viscosity, and lubricity testing.

6.15 DIESEL FUEL STABILIZER ADDITIVE.

A diesel fuel stabilizer additive, MIL-S-53021, is available for certain situations. This product was developed in response to fuel-related operational problems. Most often, the problems are filter plugging, but incidents of injector seizure and filter neck corrosion have also occurred. The stabilizer additive package contains antioxidant, biocide, corrosion inhibitor, dispersant, and metal deactivator. Treatment cost is approximately 1 cent per gallon of fuel.

a. The stabilizer additive package is most effective when added to clean, fresh fuel as a preventative measure. After the fuel has started to deteriorate, the additive only slows down or stops the process, but cannot restore the deteriorated fuel to its original condition. The additive package is not required for routine use in all vehicles. It should be used primarily in situations in which fuel or equipment is subject to long-term storage, infrequent use, or where higher fuel stability is required.

b. There are 2 types of stabilizer additives that have been qualified: a 2-package and a 1-package system. Both systems meet all requirements of MIL-S-53021. In the 2-package system, the biocide is in 1 package or container, and the remaining additives are in the other. Both of them must be ordered and used together for maximum effectiveness. Both components of the 2-package system are used at the rate of 1 gallon per 5000 gallons of fuel. Ordering information for the 2-package system is as follows:

Name	Container Size	NSN
Biocide	5-gal can	6840-01-173-6940
Stabilizer Additive	5-gal can	6840-01-173-6940
Biocide	55-gal drum	6840-01-041-0098
Stabilizer Additive	55-gal drum	6840-01-167-4788

The 1-package type stabilizer has the additives and biocide blended together in 1 container. It is used at the rate of 1 gallon of additive per 3500 gallons of fuel. Ordering information is as follows:

Name	Container Size	NSN
Stabilizer Additive	5-gal can	6850-01-246-6544
Stabilizer Additive	55-gal drum	6850-01-246-6545

c. Read the instructions on the container and the MSDS before handling the additives. Use the recommended protective equipment. In case of leaks or spills, follow the instructions in the MSDS for disposal.

d. The most effective method for additizing is by injection to a moving stream of fuel. If this cannot be accomplished, introduce the additive to a partially or half-filled tank and receive product to fill the tank. For additional information contact DET 3, WR-ALC/AFTH, DSN: 785-8070.

6.16 BIODIESEL (B20).

B20 is a methyl ester product derived from a mixture of 80 percent Low Sulfur (LS) diesel fuel and 20 percent biodiesel. Biodiesel performs comparably to diesel, offers excellent lubricity, and is noted as being a safe fuel to use, handle, and store. Biodiesel can be used to meet alternate fuel vehicle purchase requirements of the Energy Policy Act of 1992 and the goals of Federal Executive Order 13149.

a. Conversion to B20 – conversion from low sulfur diesel to B20 requires the removal of the existing diesel fuel stocks to the maximum extent possible.

b. Satisfactory conversion can be accomplished as follows:

(1) Empty tank as thoroughly as possible with service pump and remove the remaining product with the appropriate equipment. Clean the tank.

(2) Install a 10-micron spin-on filter on the island pump(s).

(3) After the initial B20 receipt, dispense at least twice the piping fill quantity through the pump/hose/nozzle to purge the system.

6.16.1 B20 Receipts. Visual inspection will be required for both identification and quantity. If there is evidence that deliveries are not in conformance with the specification/contract, obtain assistance from DET 3, WR-ALC/AFTH.

a. Verify the T/T contains B20 (already premixed). Product shall be blended prior to delivery. Manifold blending at time of delivery and blending at the time of delivery in the receipt tank is not permitted. The resultant blended product must meet all performance requirements specified in the contract.

b. Take two one-gallon samples from either the discharge manifold, or the compartment from the top of the trailer.

c. Take a one-quart bottle sample during discharge from the off-loading header at a point as close as possible to the T/T. Take the sample after the line fill has been displaced and perform the visual inspection immediately thereafter. The product shall be free of solids and water.

d. Test one of the one-gallon samples of fuel from the delivery conveyance for flash point. Minimum flash point for B20 shall be 126°F (52°C) with blend stocks of DF-2, DL-2 or LS-2. During cold weather months (October to March) flash point shall be minimum 100°F (38°C) with blend stocks of DF-1, DL-1 or LS-1, or per the performance requirements specified in the contract. Additionally, during the months of October thru March, perform a CFPP and/or cloud point (refer to Paragraph 6.13, Cold Weather Operations). If the first analysis fails any property, perform a retest. In the event of a second failure, notify DET 3, WR-ALC/AFTH for guidance. The second one-gallon sample will be marked and saved as a RETAIN sample. This sample will be returned to bulk once the product is consumed, or after the next receipt, whichever occurs first. It is important that this RETAIN sample is correctly marked to identify the date and exact source of the sample to include conveyance truck and trailer number.

e. Deleted

6.16.2 Periodic Sampling and Testing. Take a one-gallon sample every 90 days from a dispenser nozzle at the base service station representative of the tank on issue and submit the sample to the servicing aerospace fuels area laboratory. The area laboratory will perform the following tests:

- Appearance
- Density
- Flash Point
- Sulfur Content
- Water and Sediment
- Particulates
- Distillation
- Acid Number
- Copper Strip Corrosion

Additionally (October to March), cloud point or CFPP will be performed.

6.17 B20 LOW TEMPERATURE PERFORMANCE.

a. Unless a more restrictive cloud point limit is specified in the contract schedule, the cloud point tested in accordance with ASTM D 2500 shall be equal to or lower than the tenth percentile minimum ambient temperature in the geographical area and seasonal time frame in which the B20 is to be used, as specified in Table 6-2 of this publication.

b. Unless a more restrictive CFPP limit is specified in the contract schedule, the maximum CFPP of the B20 shall be a minimum of 10°C below the tenth percentile minimum ambient temperature in the geographical area and seasonal time frame in which the B20 is to be used, when tested in accordance with ASTM D 6371.

c. In the event of a sample failure, initiate a Quality Deficiency Report (QDR), and notify DET 3, WR-ALC/AFTH, DSN: 785-8070.

6.18 HEATING FUEL OIL.

On receipt, verify grade.

a. Sample each grade of fuel oil or diesel used for heating each six months. Take the sample from a source that is representative of the fuel oil or diesel fuel that is routinely consumed for heating by the installation.

b. Samples will be taken by the agency (Logistics Readiness or Civil Engineer), which receives and accepts the product for the installation. Samples will be submitted to fuels management for shipment to the area laboratory. Samples will be taken in one-gallon cans furnished by fuels management and identified with AFTO Form 475 sample tags referencing this paragraph.

c. The area laboratory will determine percent sulfur, gross BTU/gallon, and flash point. The installation will send a copy of the test report to the MAJCOM Civil Engineer.

Table 6-1. Minimum Sampling and Testing Frequencies of Dormant Petroleum Products

Specification	Nomenclature	Sampling Frequency/Months
A-A-52557	Fuel Oil, Diesel	6
MIL-F-16884	Fuel, Naval Distillate	6
ASTM D 396	Fuel Oil, Burner	6
ASTM D 439	Gasoline, Leaded and Unleaded	6
MIL-G-3056	Gasoline, Automotive, Combat	6
A-A-52530	Gasohol	3
ASTM D 3699	Kerosene	6
Various Specifications	All Turbine Fuels	6
ASTM D 910	AVGAS	6

NOTES:

1. Sample size for all products is one-gallon except turbine fuel which is 2 gallons.

2. Prior to sampling, rinse cans with the product to be sampled. This excludes burner fuels which will be sampled into a clean dry can.

3. Sample all drummed products using the minimum sampling frequency specified for the grade of product involved. Take a one-gallon sample from one drum representative of the product by grade and packaging date or date of receipt.

Table 6-2. Tenth Percentile Minimum Temperatures, °F

State	SEP	OCT	NOV	DEC	JAN	FEB	MAR
Alabama	55	39	27	21	19	27	28
Alaska:							
Northern	19	–13	–35	–49	–56	–53	–44
Southern	30	12	9	0	–26	–26	–20
South East	34	25	12	3	–2	9	10
Arizona:							
N 34 LAT	34	25	10	7	1	3	10
S 34 LAT	55	45	32	28	25	27	30
Arkansas	48	36	25	19	12	19	27
California:							
N Coast	43	37	32	28	28	30	30
S Coast	45	43	36	32	30	32	36
Interior	43	36	27	25	19	21	21
Southeast	43	34	21	17	12	19	23
Colorado:							
E 105 LONG	39	28	10	7	–2	5	10
W 105 LONG	27	18	0	–18	–22	–11	3
Connecticut	39	30	19	3	1	3	16
Delaware	46	36	27	14	12	14	23
Florida:							
N 29 LAT	57	45	30	28	26	30	36
S 29 LAT	63	57	45	38	38	41	45
Georgia	54	37	28	21	19	21	28
Idaho	36	25	9	0	–6	0	9
Illinois:							
N 40 LAT	39	30	16	–5	–8	0	12
S 40 LAT	46	34	19	3	1	5	17
Indiana	43	30	19	3	0	3	16
Iowa	39	28	9	9	–15	–8	3
Kansas	39	28	12	5	–2	7	9
Kentucky	45	34	21	9	7	12	21
Louisiana	57	41	30	27	25	28	34
Maine	34	27	14	9	–15	–15	0
Maryland	46	36	27	14	10	14	25
Massachusetts	37	28	19	3	0	1	14
Michigan	34	28	12	–4	9	9	0
Minnesota	30	25	0	–22	–29	–24	11
Mississippi	55	37	27	21	21	25	30
Missouri	46	34	19	7	3	9	18
Montana	30	19	0	–11	–22	–11	–6
Nebraska	37	27	9	0	–8	–2	9
Nevada:							
N 38 LAT	28	19	7	1	–8	0	9
S 38 LAT	57	45	32	27	25	28	34
New Hampshire	34	27	18	0	–5	–6	10

Table 6-2. Tenth Percentile Minimum Temperatures, °F - Continued

State	SEP	OCT	NOV	DEC	JAN	FEB	MAR
New Jersey	46	36	27	12	10	12	21
New Mexico:							
N 34 LAT	35	28	12	7	1	7	12
S 34 LAT	41	39	25	18	12	19	27
New York	34	27	18	–6	–11	–11	3
North Carolina	43	30	19	14	12	16	23
North Dakota	34	25	–4	–17	–24	–20	–8
Ohio	39	30	19	3	1	5	16
Oklahoma	48	34	18	10	9	18	19
Oregon:							
E 122 LONG	30	21	12	7	–2	–6	16
W 122 LONG	39	32	25	23	19	25	27
Pennsylvania:							
N 41 LAT	32	27	18	–4	–5	–6	5
S 41 LAT	36	32	21	9	7	7	18
Rhode Island	43	34	27	10	9	9	19
South Carolina	55	41	30	23	23	27	28
South Dakota	37	25	7	–11	–17	–11	0
Tennessee	45	34	23	16	12	16	25
Texas:							
N 31 LAT	48	37	21	16	9	16	19
S 31 LAT	61	48	36	28	27	30	36
Utah	39	28	12	7	0	7	18
Vermont	37	27	18	–4	9	–11	5
Virginia	46	36	27	16	12	16	25
Washington:							
E 122 LONG	36	28	18	12	0	12	18
W 122 LONG	37	32	27	27	19	25	17
West Virginia	37	27	18	5	3	7	16
Wisconsin	36	27	7	–11	–18	–11	0
Wyoming	34	25	5	0	–15	–2	3

Overseas 10th Percentile Minimum Temperatures, °F

Country	OCT	NOV	DEC	JAN	FEB	MAR	APR
Austria	30	23	10	14	16	21	30
Belgium	32	27	16	19	21	21	27
Denmark	30	27	21	19	19	19	27
France	32	28	16	16	23	23	30
Germany	28	23	9	9	10	16	23
Greece	41	32	27	27	28	30	37
Iceland	30	23	19	16	19	19	25
Italy	34	27	21	18	19	27	30
Korea	34	21	9	–4	5	19	30
Luxembourg	34	27	19	19	21	25	28
Netherlands	32	28	18	18	21	23	28

Table 6-2. Tenth Percentile Minimum Temperatures, °F - Continued

Overseas 10th Percentile Minimum Temperatures, °F							
Country	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**
Norway	21	7	3	0	0	3	21
Portugal	46	39	34	34	34	34	41
Turkey	30	21	14	3	3	21	30

NOTE

Minimum daily temperatures complied from weather stations were statistically evaluated to determine the probability for various temperature occurrences. A method of reporting this probability is with the use of percentiles which evaluate the complied distribution and report the temperatures corresponding to their probabilities of occurrence. To predict limiting low ambient temperatures, the 10th percentile minimum temperature values have been selected as a realistic guide. By definition, the 10th percentile minimum temperature predicts a 10% chance that the daily minimum will be lower than the predicted value, or a 90% chance that the daily minimum will be no lower than the predicted value.

Table 6-3. Blending Fluids for DL-2 Diesel

NATO Code	Nomenclature	Specification	Freeze Point	Stock Number
F-44	Turbine Fuel	MIL-DTL-5624, Grade JP-5	–51°F (–46°C)	9130-00-273-2379 (bulk)
F-34	Turbine Fuel	MIL-DTL-83133, Grade JP-8	–53°F (–47°C)	9130-01-031-5816 (bulk)
	Commercial Turbine Fuel	ASTM D 1655, Jet A	–40°F (–40°C)	9130-00-359-2026
	Commercial Turbine Fuel	ASTM D 1655, Jet A-1	–53°F (–47°C)	9130-00-753-5026
F-58	Kerosene	ASTM D 3699	–2°F (–18°C)	9140-00-247-6748 9140-00-273-2394 (drum)

Table 6-4. DL-2 Blending Ratio for +20° to –24°F Cloud Point

DESIRED CLOUD POINT	INITIAL CLOUD POINT																							
	20	18	16	14	12	10	8	6	4	2	0	-2	-4	-6	-8	-10	-12	-14	-16	-18	-20	-22	-24	
	GALLONS OF BLENDING FUEL TO ADD TO 100 GALLONS DL-2																							
20	0																							
18	10	0																						
16	21	10	0																					
14	32	21	10	0																				
12	43	32	21	10	0																			
10	62	48	34	22	12	0																		
8	85	67	52	37	25	11	0																	
6		85	67	52	37	22	8	0																
4			85	67	52	35	14	8	0															
2				85	67	47	22	15	7	0														
0					89	67	30	22	14	7	0													
-2						82	48	37	25	18	12	0												
-4							70	57	43	34	25	12	0											
-6							79	64	50	39	30	15	4	0										
-8							86	70	54	43	34	20	7	4	0									
-10								89	70	52	45	27	13	9	7	0								
-12									93	73	57	36	20	15	12	5	0							
-14										82	64	41	24	20	14	8	4	0						
-16										89	70	45	27	22	18	10	6	3	0					
-18											79	52	32	27	22	14	9	6	4	0				
-20											89	59	37	32	27	18	13	9	7	4	0			
-22												67	43	37	32	22	17	13	10	7	4	0		
-24												76	50	43	37	27	21	17	14	10	7	4	0	

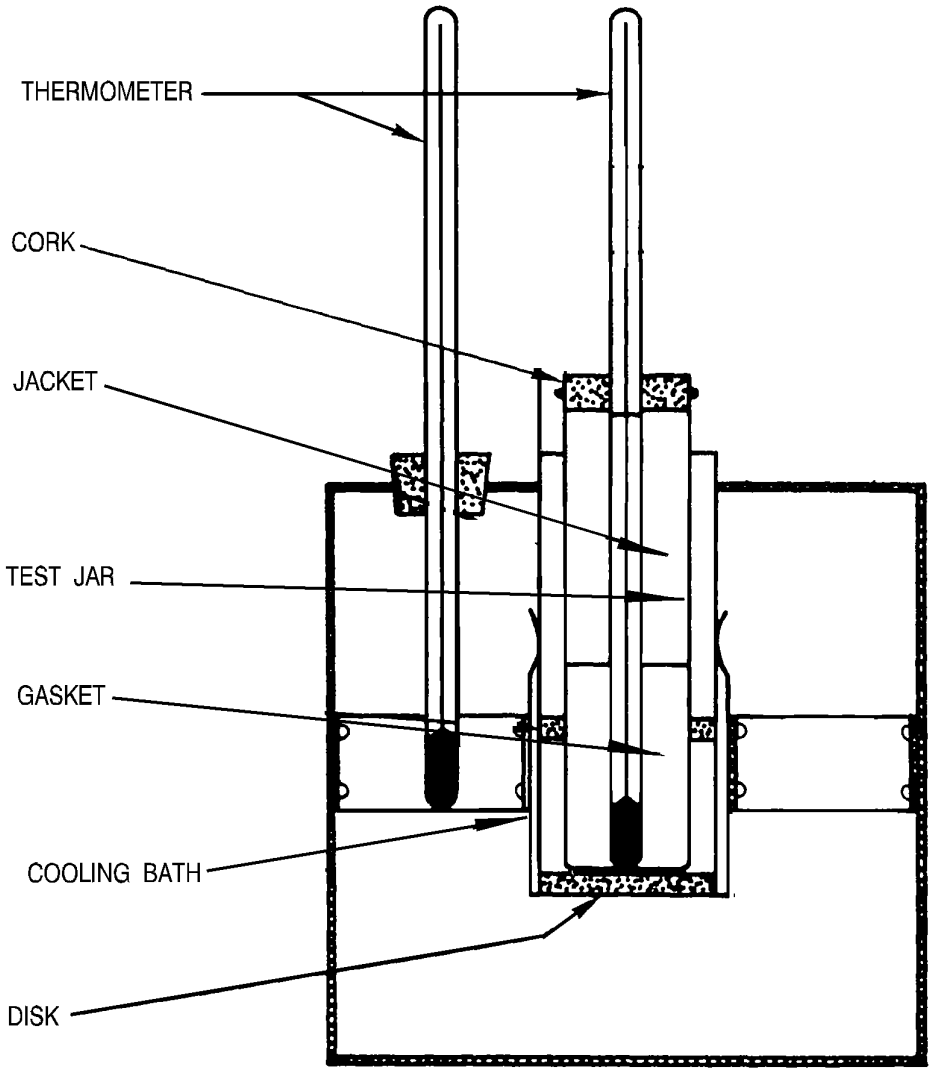


Figure 6-1. Cloud Point Test Apparatus

CHAPTER 7
QUALITY CONTROL PROCEDURES AT TEMPORARY AND AUXILIARY LOCATIONS

7.1 GENERAL.

a. This chapter contains sampling and testing instructions for aviation fuels at temporary sites and auxiliary locations where a fuels laboratory is not available. These procedures do not exempt active units from establishing and operating a fuels laboratory at permanent installations.

b. Personnel responsible for handling fuels and lubricants shall be thoroughly trained and fully qualified to perform their assigned responsibilities. They shall be aware of the hazards in handling fuels and lubricants, as well as the applicable safety and operating procedures.

c. Precautions should be made to ensure representative sampling is dependent on the type of product being sampled, the type of container from which it is drawn, and the sampling procedures employed.

d. Because samples taken improperly can invalidate a test, only trained and experienced personnel shall be assigned to the task of sampling. No amount of laboratory work will give reliable results on a product if the sample is not a true representative of that product.

7.2 SAMPLING REQUIREMENTS.

a. Turbine fuels will be sampled and tested at forward operating locations IAW Table 5-1 and Table 7-1. Where the bottle method is specified for solids tests in Table 5-1, substitute by using the color and particle assessment method.

b. AVGAS samples will be checked for solids and water at the locations and frequencies required in Table 5-3. Disregard in Table 5-3, the requirement to determine quantitatively the solids content of AVGAS on receipt, when the visual sample is suspect. Solids will be determined visually upstream of filter separators and by the particle assessment method downstream of filter separators. Color assessment is not applicable to AVGAS. Water content of AVGAS will be determined visually. The heavy hydrocarbon contamination test for AVGAS will be performed onsite by the method detailed in Chapter 5.

7.3 SOLIDS DETERMINATION.

a. Solids content in turbine fuels will be determined by the color and particle assessment method described in Chapter 5. For rating solids content in AVGAS use only the particle assessment scale. Should the particle rating for AVGAS or the particle and/or color rating for turbine fuels fail, the fuel must then be resampled. Upon verification of the unacceptable ratings, investigate the cause of failure. Filter or filter separator elements will be changed when solids or water limits exceed the limits specified in Table 5-1 and Table 7-1.

b. The color and particle assessment method requires use of the in-line sampler with quick-disconnects installed in the fuel system as outlined in Chapter 5. A minimum of 10 psig is required at sampling points to permit flow through the sampler. At sampling points with inadequate pressure or where quick-disconnects cannot be installed, the visual inspection procedures of Chapter 5 will be used in lieu of the color and particle assessment method.

7.4 SUBMISSION OF TURBINE FUEL SAMPLES.

Using an in-line sampler, a minimum of 2 one-gallon samples, representative of fuel issued to aircraft, will be taken upon unit arrival and every 45 days thereafter. Sample downstream of the last filtration prior to the aircraft, i.e., from a hose cart, refueler, or R-14. Identify this sample as AIRCRAFT SERVICING SAMPLE on the AFTO Form 475. Forward aircraft servicing samples to the Air Force Aerospace Fuels Laboratory which is responsible for the Area of Operation (AOR). Refer to Table 4-1 of this publication. Area laboratories will provide an analysis for B-1 + JFTOT and BOCLE.

NOTE

Forward operation locations in combat/contingency zones and base operations less than 45 days duration are exempt from submitting the samples specified in Paragraph 7.4. However, fuels activities at locations for greater than 45 days shall establish a base laboratory capable of performing flash point, FSII content, conductivity, particulate matter by bottle method, and water content by Aqua-Glo or AEL.

7.5 BLENDING ADDITIVES INTO TURBINE FUELS.

When it is necessary to blend FSII, CI/LI, or SDA into turbine fuels, refer to APPENDIX A of this publication for guidance.

Table 7-1. Turbine Fuel Sampling Requirements and Test Limits

Item	Sample Point	Test	Test Limits	Sample Frequency
1.	Pipeline Receipts.			
1a.	Downstream of Receipt Filter Separator, i.e., FFU 15E.	Visual for color, water, and solids.	Clear and bright and visually free of water and solids.	Each receipt, one hour after start, or after line displacement (whichever occurs first) and at each four-hour interval thereafter. Sample after F/S elements are changed.
		Solids/DP	Color and particle assessment method.	
		FSII	See Table 5-2 if applicable.	
		Conductivity	See Table 5-2 if applicable.	
		Water (Aqua-Glo or AEL)	10 ppm	
		Flash Point	See Table 5-2.	
		API Gravity	See Table 2-1.	
2.	Tank Truck/Tank Car Receipts.			
2a.	Tank Truck/Tank Car Downstream of Receipt Filter Separator, i.e., FFU 15E.	Visual for color, water, and solids.	Clear and bright and visually free of water, and solids.	One sample daily from one TT/TC from each supplier. Locations receiving fuel that has been hand doped or had a single compartment doped with SDA will comply with Paragraph A.4, Step b. Sample after F/S elements are changed.
		Solids/DP	Color and particle assessment method.	
		FSII	See Table 5-2 if applicable.	
		Conductivity	See Table 5-2 if applicable.	
		Water (Aqua-Glo or AEL)	10 ppm	
		Flash Point	See Table 5-2.	
		API Gravity	See Table 2-1.	
3.	Air Transportable Hydrant Refueling Systems, R-14.	Solids/DP	Color and particle assessment method.	Every 7 days. Equipment not used within 7 days will be sampled prior to or during the first servicing operation. After F/S elements are changed, sample prior to or during first servicing operation. After maintenance that can affect fuel quality is performed, or there is a fuel grade change, the equipment will be sampled prior to servicing aircraft.
		Water	10 ppm	

Table 7-1. Turbine Fuel Sampling Requirements and Test Limits - Continued

Item	Sample Point	Test	Test Limits	Sample Frequency
		Fibers	10 per quart	After F/S elements are changed, sample prior to or during first servicing operation. When used to service aircraft or for last filtration, sample prior to or during first servicing operation following F/S element change.
		FSII	See Table 5-2.	Take a minimum of 1 sample per day from one R-14. Schedule sampling to assure all active R-14's are sampled weekly. R-14's not used within 7 days will be sampled prior to the first servicing operation.
		Conductivity	See Table 5-2.	
4.	FFU 15E other than used in Receipt Operations, i.e., Truck Fillstand Operations/Aircraft Servicing Operations.	Solids/DP	Color and particle assessment method.	Every 7 days. Equipment not used within 7 days will be sampled prior to or during the first servicing operation. After F/S elements are changed, sample prior to or during first servicing operation. After maintenance that can affect fuel quality is performed, or there is a fuel grade change, the equipment will be sampled prior to servicing aircraft.
		Water	10 ppm	
		Fibers	10 per quart	After F/S elements are changed, sample prior to or during first servicing operation. When used to service aircraft or for last filtration, sample prior to or during first servicing operation following F/S element change.
		FSII	See Table 5-2.	Take a minimum of 1 sample per day from one FFU 15E. Schedule sampling to assure all active FFU 15E's are sampled weekly. FFU 15E's not used within 7 days will be sampled prior to the first servicing operation.
		Conductivity	See Table 5-2.	

CHAPTER 8
AIRCRAFT ENGINE OILS AND OTHER PETROLEUM PRODUCTS

8.1 GENERAL.

This chapter contains quality control and shelf-life procedures for bulk and packaged lubricants and other petroleum products under FSC 9150 and 9160. While the material is in stock control and after it is issued to the using activity, it must be systematically inspected to detect degradation, deterioration, corrosion damage, and other deficiencies caused by improper storage methods, expiring shelf-life, or the material's inherent deterioration characteristics. The focus should be on detecting minor deficiencies before they become significant, thus providing time for corrective actions before the material becomes unserviceable or unusable and requires disposal as hazardous waste.

8.2 UNOPENED PACKAGED PETROLEUM PRODUCTS.

a. Storage personnel are responsible for executing the control program directed by their component and installation. Effective shelf-life control at the warehouse level requires vigilance by all personnel, careful supervision, and understanding of the intent and purpose of the control procedures.

b. General Housekeeping – good housekeeping practices and protection from the elements are major factors in the quality of these products. In addition to stock rotation procedures outlined in AFMAN 23-110, Vol 7, the following practices will help preserve the quality of these products.

(1) Segregate and properly identify each product.

(2) Rotate product on a FIRST-IN-FIRST-OUT basis. It is preferable that the oldest product, based upon date of manufacture (not current shelf-life date), be consumed prior to products with more recent dates of manufacture.

(3) Maintain a clean area and prevent water contamination.

(4) Insure that product labels are legible. Remark containers with correct information if labels are becoming illegible. Do not place reinspection labels over product data required for updating (NSN, contract, and batch numbers).

(5) Read labels before dispensing lubricants to equipment to insure that the correct products are being used.

(6) Keep lids and screw caps on containers.

(7) Store products indoors whenever possible.

(8) Use containers only for the products for which they are intended.

c. Housekeeping of WRM Products – per AFMAN 23-110, Vol 7, Part 3, 1.5.7, WRM will be rotated with peacetime consumables to protect their continued serviceability and are subject to the same retest and housekeeping procedures as peacetime stocks. Bases maintaining large quantities of aircraft and engine oil WRM may experience difficulty rotating stocks due to low peacetime operating consumption. Twelve months before expiration of shelf-life, request assistance to redistribute stock by contacting DET 3, WR-ALC/AFTT, 2430 C Street, Bldg 70, Area B, Wright-Patterson AFB, OH 45433-7632, or call DSN: 785-8050. A web site is now available on the Internet for DoD customers to access retest/update information for petroleum, oil, and lubricant products. The web site address is: https://afpet.wpafb.af.mil. For access, Internet Explorer 5.0 or better with 128-bit encryption is required.

d. Return of Packaged Products from Using Organizations – in some situations, using activities cannot consume some products and must return these to stock for reissue. Only products in original unopened containers will be returned to supply for reissue. Paragraph 8.4 provides instructions for unused fluid in opened containers.

e. Receipt of Overage Product from DLA Depots – if overage product is received from DLA depots, submit a Supply Discrepancy Report (SDR) using SF364 form to: Defense Supply Center Richmond, ATTN: DSCR-JDTA, 8000 Jefferson Davis Highway, Richmond, VA 23297-5810. A photocopy of any SDR submitted should also be submitted to: DET 3, WR-ALC/AFTT, 2430 C Street, Bldg 70, Area B, Wright-Patterson AFB, OH 45433-7632.

f. Due to changes in the way that DLA procures packaged products, important information may not appear on every container. Frequently, this information is shown only on the outside carton. Once the carton is opened, individual containers must be inspected for proper markings in accordance with MIL-STD-129. If the complete information is not found on each container, the supply inspector must transfer all required identification from the labeling on the carton to the containers by some permanent means, such that the information cannot be erased

and/or lost. In the event that the date of manufacture is not shown either on the carton or the containers, the date of receipt from the contractor, DLA or GSA will be used as the approximate date of manufacture for retesting purposes. The following information must show on each container:

1. National Stock Number (NSN)
2. Contract Number
3. Batch/Lot Number
4. Specification Number as Applicable
5. Date of Manufacture (DOM)
6. Reinspection Date
7. Manufacturers Name and Federal Supply Code Number (FSCM)
8. Chemical Nomenclature
9. DOT Marking Requirements

8.3 EXTENSION OF PACKAGED PETROLEUM PRODUCTS.

a. Frequency – Table 8-1 and Table 8-2 specify the retesting frequency for packaged petroleum products. The date of package or manufacture will be used to calculate the initial retest date. Subsequent updates will be calculated based upon date of last reinspection and the retest frequency of the product.

b. Inspection Intervals – stocks should be inspected at least quarterly for material which is overage (expired shelf-life) or for material which will expire before the next scheduled inspection. Air Force supply activities finding items approaching expiration dates during quarterly inspections shall initiate updating/sampling procedures 60 – 90 days prior to retest due dates.

c. Air Force Petroleum Office Shelf-Life/Retest Program – if material nearing its expiration date is found in stock, check the AFPET website at https://afpet.wpafb.af.mil. Contact DET 3, WR-ALC/AFTT, DSN: 785-8050 if additional information is needed and/or disposition instructions.

d. Laboratory Results – the testing laboratory will advise the submitting activity of the test results. If the product is satisfactory for use, the next reinspection date will also be provided.

e. Solid Film Lubricants – All solid/dry-film lubricants, whether purchased under a product specification or as a proprietary item, should be discarded through Defense Reutilization and Marketing Office (DRMO) channels twelve (12) months after the packaging date unless otherwise indicated by the manufacturer or by Table 8-2.

f. Proprietary Items – proprietary items (those products not conforming to either a military, federal, or commercial specification), with the exception of solid/dry-film lubricants, do not require reinspection testing unless listed in Table 8-1. Perform a visual inspection of proprietary items at least every 12 months and at the time of issue/use. These products are suitable for use until visual inspection indicates product and/or container deterioration. Products which fail the visual inspection should be sent to the servicing DRMO for disposal.

g. Product Updates – products with valid updates should be so marked by attaching an AF Form 2032 to the product with the new retest date. Products conforming to Step f above, shall be given a 12-month extension from the date of inspection. Other products shall be marked as appropriate.

h. Clarification – if the organization is at any time unsure of a correct course of action, contact WR-ALC/AFTT, DSN: 785-8050, for clarification.

i. Order of Precedence – there are other shelf-life programs available in the DoD system that provide update information for various Federal Stock Classes. In the event of a conflict between another program containing information on the 9100 and 6800 stock classes and the AFPET shelf-life/retest program, AFTT's test results and disposition instructions will take precedence for Air Force organizations.

8.4 SPECIAL INSTRUCTIONS FOR OPENED CONTAINERS.

a. General Housekeeping – the same good housekeeping instructions apply equally to opened products as to unopened products. Extra care must be taken to ensure no water or other foreign material is introduced into the containers.

b. Shelf-Life of Opened Containers – field activities are advised that shelf-life applies to opened containers. Opened containers should be consumed prior to shelf-life expiration to the greatest extent possible. Activities are cautioned that product quality may be compromised due to contamination or degradation if the contents are not consumed within 90 days of opening, and the user should visually inspect an open product for physical

appearance and/or contamination before use. If the product appears to be altered, dispose of the material through DRMO.

c. Unused Hydraulic Fluids/Turbine Engine Oils – unused hydraulic fluid or turbine engine oil remaining in open one-quart or gallon containers after equipment servicing will not be retained for future use. It will be segregated and collected IAW T.O. 42B-1-23 to reduce the possibility of using contaminated product. T.O. 42B2-1-3 provides detailed instructions on the handling of these items.

8.5 SUBMISSION OF SAMPLES.

a. Prior to Submission – DET 3, WR-ALC/AFTT shall be contacted prior to submission of reinspection samples. Exact sample sizes, based upon cost analysis, testing requirements, and container size, will be provided at that time.

b. Liquid Samples – samples of lubricating oils and other liquid petroleum products will be a maximum of 1 gallon unless otherwise directed by AFTT. If the product container size is larger than the sample size, sample shall be drawn into an appropriately sized, clean sample container. When product is to be withdrawn from a five-gallon or larger container it is recommended that sample can, NSN 8110-01-371-8315, be used for submitting sample.

c. Grease Samples – grease samples will be a minimum of 3 pounds and a maximum of 5 pounds unless otherwise directed by AFTT. If the product container size is larger than the sample size, sample shall be drawn into an appropriately sized, clean, wide-mouthed container. Sample can, NSN 8110-00-178-8292, is recommended.

CAUTION

DO NOT overpack samples in vermiculite. This could cause false test results of sample. See Step d below.

d. Packing Materials – vermiculite or vermiculite-type packing will not be used to overpack samples. Vermiculite splinters cannot be fully removed from the container mouth and will contaminate the sample, causing suspect test analysis.

e. Partial Samples – when the sample size is only part of the individual container, the remaining quantity shall be held and treated as a full container.

f. Sample Identification – all samples sent to Aerospace Fuels laboratories must be properly identified and tagged with an AFTO Form 475. Mark the sample: FOR REINSPECTION TESTING. Refer to Table 8-3 for areas of responsibility of laboratories.

8.6 SPECIAL INSTRUCTIONS FOR PACKAGED AIRCRAFT ENGINE OILS.

T.O. 42B2-1-1 details the use of these oils which are packaged in drums, one- and five-gallon containers, quarts, and half-pints. Base level operations primarily use one-quart and one-gallon hermetically sealed containers. Cartons of these containers are stored in base supply warehouses and flight line shops. The cans or cartons will not be subjected to rough handling which could cause leaks and result in unusable oil. Drummed turbine engine oils are procured for test cell operations.

a. Packaged turbine engine oils (i.e., MIL-PRF-7808, MIL-PRF-23699) are subjected to quality assurance testing prior to product receipt. If a batch is found unsuitable for use, AFTT will advise base supply accounts by message to discontinue use of that particular batch. Air Force activities need only follow prescribed handling procedures to assure quality of these products.

b. Special Instructions – turbine engine oils are given special supply and quality treatment because turbine engines can tolerate very little extraneous material. DLA depots ship these oils to CONUS bases only when the age of the material is 12 months or less. Material destined for overseas activities must be less than 6 months old. This usually provides sufficient time for Air Force activities to use the oil within 36 months from the date of packaging.

c. Stock Rotation – stocks of turbine oils should be rotated by Supply and using organizations to ensure use before shelf-life expiration. If the oil cannot be used in 36 months, follow the instructions in Paragraph 8.3 for shelf-life product extension or disposition.

Table 8-1. Retest Frequency of Tested Proprietary Products

NSN	Nomenclature	Retest Frequency in Months	Responsible Laboratory
9150-00-076-1582	Grease, Ordinance, Extreme Pressure Molybdenum Disulfide (Molykote 77)	24	AFTLA
9150-00-135-2634	Lubricant Oil, Engine (Shell Caprinus 40)	24	Area
9150-00-419-0628	Grease, Extreme Pressure (FMS-1071)	24	AFTLA
9150-00-419-0629	Grease, Extreme Pressure (FMS-1071)	24	AFTLA
9150-00-506-8497	Grease, Helicopter Driveshaft Coupling	Discard after 48 months	
9150-00-735-1800	Grease, Silicon-Graphite (Molykote 41)	24	AFTLA
9150-00-913-9717	Lubricating Oil, Aircraft Turbine Engine (Mobil Jet II)	36	AFTLA
9150-00-926-9108	Damping Fluid, Polymer of Bromo-trifluorethylene	36	AFTLA
9150-00-985-7317	Grease, Ordinance, Extreme Pressure Molybdenum Disulfide (Molykote 77)	24	AFTLA
9150-00-985-7318	Grease, Ordinance, Extreme Pressure Molybdenum Disulfide (Molykote 77)	24	AFTLA
9150-01-056-4883	Hydraulic Fluid, Fire-Resistant (Boeing BMS 3-11)	24	AFTLA
9150-01-152-1094	Lubricant Oil, Gear	36	Area
9150-01-256-6433	Hydraulic Fluid, Fire-Resistant (Naval Drawing 6296865)	24	Area
9150-01-263-7239	Lubricating Oil, Steam Turbine (Naval Drawing 6381771)	24	Area
9150-01-263-7241	Lubricating Oil, Steam Turbine (Naval Drawing 6381771)	24	Area
9150-01-263-7242	Lubricating Oil, Steam Turbine (Naval Drawing 6381771)	24	Area
9150-01-263-7243	Fluid, Power Transmission (Naval Drawing 6381773)	24	Area
9150-01-263-7244	Hydraulic Fluid, Fire-Resistant (Naval Drawing 6296865)	24	Area
9150-01-263-8427	Fluid, Power Transmission (Naval Drawing 6381773)	24	Area
9150-01-264-2639	Hydraulic Fluid, Fire-Resistant (Naval Drawing 6296865)	24	Area

8.7 BULK AVOIL.

SAE J1899 (MIL-L-22851) and MIL-PRF-6081 (MIL-L-6081) are bulk oils used by the Air Force. SAE J1899 is used for reciprocating engines. It is a viscous petroleum oil blended with an additive package designed to provide dispersant properties. It is often referred to as an ashless dispersant oil. MIL-PRF-6081 is a lubricating oil for use in specific models of aircraft engines. It is also used as a preservative for stored jet engines and as a fog oil for aerial demonstrations.

a. Receipts – the same precautions are observed for AVOIL as those prescribed for AVFUELS in Chapter 5. Inspect the 60-mesh line strainers in the bulk oil receiving lines immediately prior to and after each delivery. Often contaminants found in the strainers will not be detected in visual samples

from the delivery vehicle. If product quality is questionable, contact the government representative (QAR) whose name appears on the DD Form 250. If the QAR is not available, contact DET 3, WR-ALC/AFTT, DSN: 785-8050, for assistance.

b. Quality Control – the most common problem with SAE J1899 (MIL-L-22851), Type II, oil is contamination by water. Water will be eliminated from storage tanks immediately upon discovery. A peculiar property of this oil is its appearance. Although the use limit of water in this oil is 0.5% by weight, as little as 0.2% water will cause it to look milky once it is agitated. Since the dispersant additive holds water or particles firmly, the emulsion or suspension will not break and several weeks of settling may not improve the appearance of the oil. Base laboratories are not equipped to analyze SAE J1899 (MIL-L-22851), so if contamination is suspected, a representive sample must be submitted to the area Aerospace Fuels laboratory for testing.

Table 8-2. Retest Frequency of Packaged Petroleum Products

Specification	Nomenclature	Retest Frequency in Months	Responsible Laboratory
NOTE • All Air Force users of FSG 91 products shall ensure that containers (drums, pails, cans) are not repainted to the extent that essential supply identification data are obliterated. Painting over of supply data will necessitate laboratory testing of the product to reestablish product identification and reinspection date. • Due to specification reform, some specifications may be redesignated as performance specifications (for example, MIL-L-7808 is now MIL-PRF-7808). Whether the stock has the old letter designator or the new PRF, the test requirements are the same.			
JJJ-C-86 [1]	Castor Oil, Technical	36	Area
VV-W-95 [1]	Wax, Paraffin, Technical	36	AFTLA
VV-P-216 [1]	Penetrating Oil	36	Area
VV-P-236	Petrolatum, Technical	24	AFTLA
C-O-376 [1]	Oil, Cutting, Lard	36	AFTLA
VV-G-632	Grease, General Purpose	24	AFTLA
VV-G-671	Grease, Graphite	24	AFTLA
VV-B-680 [1]	Brake Fluid, Automotive	24	Area
VV-L-800 [1]	Lubricating Oil, General Purpose, Preservative	24	Area
VV-L-825	Lubricating Oil, Refrigerant Compressor	36	Area
VV-C-846	Cutting Fluid, Emulsifiable	36	Area
VV-C-850	Cutting Fluid, Fatty and Mineral Oil	36	Area
VV-D-1078	Damping Fluid	24	Area
SAE AS1241	Hydraulic Fluid, Fire-Resistant	24	AFTLA
SAE J1703	Brake Fluid, Automotive	24	AFTLA
SAE J1899	Lubricating Oil, Aircraft Piston Engine (Ashless Dispersant)	36	Area
SAE J1966	Lubricating Oil, Aircraft Piston Engine (Nondispersant Mineral Oil)	36	Area
MIL-PRF-2104	Lubricating Oil, Engine	36	Area
MIL-PRF-2105	Lubricating Oil, Gear	24	Area
SAE J2362	Lubricating Oil, Automotive Engine, Administrative Service	24	Area

Table 8-2. Retest Frequency of Packaged Petroleum Products - Continued

Specification	Nomenclature	Retest Frequency in Months	Responsible Laboratory
SAE J2363	Lubricating Oil for Wheeled Military Vehicles with Heavy-Duty Diesel Engines	24	Area
MIL-PRF-3150	Lubricating Oil, Preservative	24	Area
ASTM D 3487	Insulating Oil, Electrical	24	AFTLA
ASTM D 960	Castor Oil, Raw	36	Area
ASTM D 961	Castor Oil, Dehydrated	36	Area
MIL-PRF-3572	Lubricating Oil, Colloidal Graphite	24	Area
MIL-G-4343 [1]	Grease, Pneumatic Systems	24	AFTLA
SAE AMS-G-4343	Grease Pneumatic Systems	24	AFTLA
MIL-H-5559 [1]	Hydraulic Fluid, Non-Petroleum Base, Arresting Gear	24	AFTLA
MIL-PRF-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance	24	Area
MIL-G-6032 [1]	Grease, Plug Valve	24	AFTLA
SAE AMS-G-6032	Grease, Plug Valve	24	AFTLA
MIL-PRF-6081	Lubricating Oil, Aircraft Turbine Engine	36	Area
MIL-L-6082 [1]	Lubricating Oil, Aircraft Piston Engine, Reciprocating	36	Area
MIL-PRF-6083	Hydraulic Fluid, Petroleum Base	24	Area
MIL-PRF-6085	Lubricating Oil, Instrument	24	Area
MIL-PRF-6086	Lubricating Oil, Gear	36	Area
MIL-PRF-7808	Lubricating Oil, Aircraft Turbine Engine	36	AFTLA
MIL-PRF-7870	Lubricating Oil, General Purpose, Low Temperature	36	Area
MIL-L-8937 [1]	Lubricant, Solid Film	Discard after 12 months	
MIL-PRF-9000	Lubricating Oil, Shipboard Diesel Engine	24	Area
MIL-PRF-10924	Grease, Automotive and Artillery	24	AFTLA
MIL-L-11734 [2]	Lubricating Oil, Synthetic	36	Area
MIL-W-12062 [2]	Wax, Petroleum	36	AFTLA
MIL-PRF-12070	Fog Oil	12	Area
MIL-W-12598 [2]	Wax, Microcrystalline	36	AFTLA
MIL-W-13945	Wax, Hydrocarbon	36	AFTLA
MIL-PRF-14107	Lubricating Oil, Weapons, Low Temperature	24	Area
MIL-G-14931 [2]	Grease, Silicone	24	AFTLA
MIL-L-15719	Lubricating Grease	24	AFTLA
MIL-DTL-17111	Fluid, Power Transmission	24	Area
MIL-DTL-17128 [2]	Transducer Fluid, Sonar	36	Area
MIL-PRF-17331	Lubricating Oil, Steam Turbine	24	Area
MIL-PRF-17672	Hydraulic Fluid, Petroleum	24	Area
MIL-W-18418	Wax, Gasket Sealing	36	AFTLA
MIL-PRF-18458	Grease, Wire-Rope, Exposed Gear	24	AFTLA

Table 8-2. Retest Frequency of Packaged Petroleum Products - Continued

Specification	Nomenclature	Retest Frequency in Months	Responsible Laboratory
MIL-H-19457	Hydraulic Fluid, Fire-Resistant, Non-Petroleum Base	24	AFTLA
MIL-L-19701	Lubricant, All-Weather, Semi-Fluid	36	AFTLA
MIL-W-20553 [2]	Wax, Desensitizing	36	AFTLA
MIL-G-21164	Grease, Molybdenum Disulfide	24	AFTLA
MIL-L-21260	Lubricating Oil, Internal Combustion Engine, Preservative	24	Area
MIL-H-22072	Hydraulic Fluid, Non-Petroleum Base, Catapult	24	AFTLA
MIL-L-22851 [1]	Lubricating Oil, Aircraft Piston Engine	36	Area
MIL-L-23398	Lubricant, Solid Film	Discard after 12 months	
MIL-DTL-23549	Grease, General Purpose	24	AFTLA
MIL-PRF-23699	Lubricating Oil, Aircraft Turbine Engine	36	AFTLA
MIL-PRF-23827	Grease, Aircraft and Instrument	24	AFTLA
MIL-L-24131	Lubricant, Colloidal Graphite/Isopropanol	Visually inspect every 12 months	
MIL-PRF-24139	Grease, Multipurpose, Quiet Service	24	AFTLA
MIL-L-24478 [2]	Lubricant, Molybdenum Disulfide/Isopropanol	Visually inspect every 12 months	
MIL-L-24479 [2]	Lubricant, Red/Lead/Graphite/Mineral Oil	Visually inspect every 12 months	
DOD-G-24508	Grease, High Performance	24	AFTLA
DOD-PRF-24574	Lubricating Fluid, Oxidizing Gas Systems	36	Area
DOD-G-24650	Grease, Food Grade	24	AFTLA
MIL-G-25013	Grease, Aircraft Ball and Roller Bearing	24	AFTLA
MIL-G-25537	Grease, Helicopter Oscillating Bearing	24	AFTLA
DOD-L-25681	Lubricant, Molybdenum Disulfide/Silicon	24	AFTLA
MIL-PRF-26087	Lubricating Oil, Reciprocating Compressor	36	Area
MIL-L-27502 [1]	Lubricating Oil, Aircraft Turbine Engine	36	AFTLA
MIL-PRF-27601	Hydraulic Fluid, Petroleum Base	24	Area
MIL-PRF-27617	Grease, Aircraft and Instrument, Fuel and Oxidizer Resistant	24	AFTLA
MIL-PRF-32033	Lubricating Oil, General Purpose, Preservative (Water-Displacing, Low Temperature)	24	AFTLA
MIL-L-45983 [2]	Lubricant, Solid Film	Discard after 12 months	
MIL-L-46000	Lubricant, Semi-Fluid	24	AFTLA
MIL-H-46001 [1]	Hydraulic Fluid, Petroleum Base	24	AFTLA
MIL-PRF-46002	Lubricating Oil, Preservative	24	Area
MIL-G-46003	Grease, Rifle	24	AFTLA

Table 8-2. Retest Frequency of Packaged Petroleum Products - Continued

Specification	Nomenclature	Retest Frequency in Months	Responsible Laboratory
MIL-PRF-46010 [3]	Lubricant, Solid Film	Visual inspection at 6 months [3] Discard after 12 months	
MIL-L-46014	Lubricating Oil, Spindle	36	Area
MIL-O-46016 [1]	Oil, Quenching	36	Area
MIL-L-46017 [1]	Lubricating Oil, Machine Tool Slideway	36	Area
MIL-C-46113 [1]	Cutting Fluid, Concentrates	36	Area
MIL-PRF-46147	Lubricant, Solid Film	Discard after 12 months	
MIL-F-46148 [1]	Fatty Oil	36	Area
MIL-C-46149 [1]	Cutting Fluid, Sulfur and Chlorine Additive	36	Area
MIL-L-46150	Lubricant, Weapons, Semi-Fluid	24	AFTLA
MIL-L-46152 [1]	Lubricating Oil, Engine	24	Area
MIL-PRF-46167	Lubricating Oil, Engine, Arctic	24	Area
MIL-PRF-46170	Hydraulic Fluid, Fire-Resistant, Rust Inhibited	24	Area
MIL-PRF-46176	Brake Fluid, Silicone	24	Area
MIL-G-46886 [1]	Grease, Silicone	24	AFTLA
MIL-L-47022 [1]	Lubricating Compound, Fluorosilicone	24	AFTLA
MIL-G-47219 [1]	Grease, Halofluorocarbon	24	AFTLA
MIL-C-47220 [1]	Coolant Fluid, Dielectric	24	AFTLA
A-A-50493	Oil, Penetrating (for Loosening Frozen Metallic Parts)	36	Area
A-A-52039 [1]	Lubricating Oil, Engine, Administrative Service	24	Area
A-A-52306 [1]	Lubricating Oil, Heavy-Duty Diesel Engine	24	Area
MIL-PRF-53074	Lubricating Oil, Steam Cylinder, Mineral	24	Area
A-A-50178	Wax, Machine Stitching	48	AFTLA
A-A-50433	Grease, Sea, Water Wash Resistant	24	AFTLA
A-A-52039	Lubricating Oil, Engine	24	Area
A-A-59004	Lubricant, Red Lead/Graphite/Mineral Oil	Visually inspect every 12 months	
A-A-59113	Lubricating Oil, Machine Tool Slideway	36	Area
A-A-59137	Lubricating Oil, Breech Block	24	AFTLA
A-A-59173	Grease Silicon	24	AFTLA
A-A-59197	Fatty Oil	36	Area
A-A-59255	Wax, Paraffin, Technical	36	AFTLA
A-A-59290	Hydraulic Fluid, Non-Petroleum Base, Arresting Gear	24	AFTLA
A-A-59354	Hydraulic Fluid, Petroleum Base	24	AFTLA
MIL-L-60326 [1]	Lubricant, Fluorocarbon Telomer Dispersion	Visually inspect every 12 months	

Table 8-2. Retest Frequency of Packaged Petroleum Products - Continued

Specification	Nomenclature	Retest Frequency in Months	Responsible Laboratory
MIL-C-63277 [1]	Coolant, Guided Boring	36	Area
MIL-PRF-63460	Lubricant, Cleaner and Preservative, Weapons	36	Area
MIL-H-81019	Hydraulic Fluid, Ultra-Low Temperature	24	Area
MIL-S-81087 [1]	Silicone Fluid, Chlorinated Methyl Phenyl Silicone	24	Area
MIL-PRF-81322	Grease, Aircraft, General Purpose	24	AFTLA
MIL-PRF-81329	Lubricant, Solid Film	Discard after 12 months	
MIL-G-81827	Grease, Aircraft, Molybdenum Disulfide	24	AFTLA
DOD-L-81846 [2]	Lubricating Oil, Instrument Bearing	24	Area
MIL-G-81937	Grease, Instrument, Ultra-Clean	24	AFTLA
MIL-PRF-83261	Grease, Aircraft, Extreme Pressure	24	AFTLA
MIL-PRF-83282	Hydraulic Fluid, Fire-Resistant	24	Area
MIL-PRF-83363	Grease, Transmission, Helicopter	24	AFTLA
MIL-L-83767	Lubricating Oil, Vacuum Pump	24	Area
MIL-PRF-85336 [2]	Lubricant, All Weather	24	AFTLA
DOD-L-85734	Lubricating Oil, Helicopter Transmission System, Synthetic Base	36	AFTLA
MIL-PRF-87100	Lubricating Oil, Aircraft Turbine Engine	36	AFTLA
MIL-L-87132 [2]	Lubricant, Cetyl Alcohol	36	Area
MIL-PRF-87252	Coolant Fluid, Hydrolytically Stable, Dielectric	24	AFTLA
MIL-PRF-87257	Hydraulic Fluid, Fire-Resistant, Low Temperature	24	AFTLA

[1] Specification has been canceled. Item may still exist in inventories.
[2] AF is not coded as a user. Item may still exist in some inventories.
[3] A visual check will be made at the end of the first 6 months. If separation has occurred and the separated solids cannot be remixed, the product is to be discarded. Otherwise, discard after 12 months.

Table 8-3. Laboratory Areas of Responsibility

Laboratory	Area of Responsibility
Wright-Patterson AFB, OH AFTLA	North and South America
RAF Mildenhall, UK AFTLF	Europe
Kadena AB, JA AFTLG	Pacific

NOTE

See Table 4-1 for addresses and telephone numbers.

APPENDIX A
ADDITIVE BLENDING PROCEDURES TURBINE FUELS

A.1 GENERAL.

WARNING

Premixing FSII and CI prior to injection will form a precipitate that will clog aircraft and refueling filters. CI and SDA are authorized for premixing prior to injection only when required by operational necessity, such as when 1 of the 3 injector pumps on an 4T4A injector is inoperative.

There are occasions when it may be necessary to blend FSII, CI/LI, SDA, or thermal stability additive into commercial turbine fuels or to upgrade the additive level in military fuels. Additive injection rate will be verified against line pressure and flow conditions on initial setup and verified every 7 days thereafter.

A.2 FUEL SYSTEM ICING INHIBITOR.

WARNING

Concentrated additive cocktails will never be added to aircraft tanks in hopes of bringing the on-board fuel within use limits.

a. When blending FSII into fuel, the desired level of this inhibitor is 0.10% by volume. Therefore, if the fuel contains no FSII, the amount of FSII to be injected is 1 gallon for every 1000 gallons of fuel. When the fuel already contains some FSII and the level needs to be upgraded, the quantity of FSII added will depend on the amount of FSII already in the fuel and the quantity of fuel involved. The following is an example of how to upgrade the FSII content of fuel:

(1) Quantity of fuel (gallons) with low FSII.

(2) Quantity of FSII (gallons) in this fuel – % FSII x Gallons of Fuel/100.

(3) Quantity of FSII (gallons if quantity in Step (1) was 0.10% – 0.10 x Gallons of Fuel/100.

(4) Difference between Steps (2) and (3) is FSII quantity in gallons to be added:

Example:

(a) 600,000 gallons of JP-8, FSII content of 0.03%.

(b) 0.03% x 600,000/100 = 180 gallons of FSII in the 600,000 gallons of fuel.

(c) 600,000 gallons of JP-8 should have 0.10% FSII content.

(d) 0.10% x 600,000/100 = 600 gallons of FSII.

(e) Subtract Step (b) from Step (c) 600 – 180 = 420.

(f) Therefore, you need to add 420 gallons of FSII to the 600,000 gallons to end up with a 0.10% FSII concentration.

b. DIEGME is stock listed under NSN 6850-01-089-5514 for 55-gallon drums and NSN 6850-01-057-6427 for bulk delivery. The flash point of DIEGME is 65°C (150°F) minimum.

WARNING

- Undiluted FSII is both combustible and toxic. It is harmful if inhaled or absorbed through the skin. It causes eye irritation. In laboratory animal studies, birth defects and adverse effects on pregnancy have been observed, and prolonged and repeated exposure has caused damage to male reproductive organs. Before handling, consult appropriate safety and occupational health authorities.
- Protective butyl rubber gloves will be worn when handling undiluted FSII. Goggles and an air purifying respirator are not required in an outdoor environment. Skin contact should be avoided but in the event of eye contact, immediately wash the eye with water. Continue to wash for 15 minutes and obtain medical aid as soon as possible. When the additive is diluted with jet fuel, the health hazards are significantly reduced.

c. Of the 3 additives discussed in this appendix, FSII is the most difficult to dissolve into the fuel uniformly. Thus, thorough mixing by circulation or movement of the fuel is necessary to obtain a homogeneous blend. The best method, excluding a proportioning injector, is to connect a small hose from the FSII drum to the suction side of the transfer pump and use the pump suction to aspirate the FSII into the fuel stream during intertank transfer operations. Another method for upgrading FSII in bulk tanks is to introduce the proper

amount of FSII to the tank heel, (not exceeding one-third the capacity of the tank), then filling the tank to capacity. When upgrading FSII content by this technique be sure to take into account the amount of the treated fuel that is in the heel of the tank before start of upgrading operations. When upgrading the FSII content of fuel in refuelers, there are 2 satisfactory techniques that can be used. The first is to introduce the required amount of FSII into the refueler hatch using a funnel and length of hose with one end submerged below the surface of the fuel. Approximately 2 quarts of fuel should be flushed through the apparatus into the refueler after introduction of the additive. Circulate the fuel in the refueler for at least 10 minutes prior to servicing. The second method for upgrading refueling units is to add the required quantity of additive through the refueler hatch into the refueler filled to not more than one-third capacity, then finish filling the unit. Fuel can then be issued without circulation.

A.3 CI/LI.

a. There are several brands of CI/LI approved for use in military turbine fuels. Qualified Product List (QPL) 25017 lists the brands and both minimum and maximum quantities permitted. When injecting CI/LI into fuel, the recommended quantity to be added is 56 ml (2 fluid ounces) for each 1,000 gallons or 15 ppm. As an example, if CI/LI is diluted with 1 part turbine fuel, then the injection rate should be 30 ppm or 112 ml (4 fluid ounces) in 1,000 gallons because of the dilution. These quantities are in the mid-range of the limits.

b. The NSN for CI/LI in 55-gallon drums is 6850-00-292-9780. For one-gallon cans, the NSN is 6850-01-180-1074.

WARNING

Protective butyl rubber gloves will be worn when handling corrosion inhibitor. Other WARNINGs that are specified for FSII in this appendix will be adhered to in handling corrosion inhibitor.

c. The same procedures recommended in this appendix for blending FSII into fuel apply for corrosion inhibitor.

A.4 SDA.

a. Stadis 450 is the brand of SDA approved for use in fuels. When blending SDA into fuel, the desired level is 200 cu. There are two dilutions, which may be used. See Table A-1 at the back of this appendix.

(1) 1:9 Blend – this is one part additive and 9 parts fuel. This dilution will be used when hand blending bulk storage tanks.

(2) 1:19 Blend – this is one part additive and 19 parts fuel. This dilution will be used when an injector is utilized.

b. Fuel received at the base outside the conductivity limits specified in this technical order will not be cause for rejection unless this has been a continual problem with the supplier. FMT should work closely with the QAR to have the quantity of SDA adjusted when the CU readings are out of limits. Receipts with small variances from the specification requirement (particularly the lower limit), should generally not pose an operational problem since on-base stocks can absorb the variance. In some cases the supplier delivering by tank truck will inject SDA in only 1 compartment of the truck that is sufficient for the entire receipt. This is to be taken into consideration when measuring CU levels during discharge. In this case, contents of the receiving tank, after discharge of tank trucks, will be measured for CU. If there is a problem with the CU results, then the QAR will be notified.

c. When CU values are between 0 and 49, add 38 ml of diluted 1:19 ratio additive per 1,000 gallons of fuel; this will generally raise the CU by 200. Since temperature of the fuel has the greatest impact on conductivity, it will normally be necessary to adjust the concentration of the SDA added when extremes in temperature are experienced. See Table 5-4 for the effect of the temperature on conductivity. For general guidance, the conductivity of a fuel will decrease 50 CU for every 15°F (8°C) drop in temperature. The reverse is true if the temperature rises 15°F (8°C).

NOTE

Always check the conductivity of the fuel before adding SDA.

d. The minimum level of 50 CU in fuel serviced to aircraft was established to provide the fuel with sufficient conductivity to quickly dissipate the static charge that is generated during fuel flow and aircraft flight. The maximum level of 700 CU in fuel serviced to aircraft was established to prevent fuel from having an adverse impact on the reliability of the aircraft's fuel quantity gauging system. Some aircraft, particularly older models, have a type of fuel quantity gauge system that is more susceptible to degradation when the fuel conductivity is high.

e. The NSN for Stadis 450 in five-gallon cans is 6850-01-099-4015. For Stadis 450 in one-gallon cans the NSN is 6850-01-097-2060.

WARNING

Protective butyl rubber gloves will be worn when handling SDA.

f. To reduce the viscosity of the additive and minimize errors in quantity measurement, the additive will be diluted with jet fuel. For on-base blending 1 part Stadis 450 in 9 parts fuels will be used. Good results are obtained by first fitting a clean 55-gallon drum with a spigot or valve for dispensing small quantities of the mix. After grounding the drum, pressurize a refueling unit hose and slowly add 45 gallons of fuel through the over-the-wing nozzle to the drum; then add 5 gallons of Stadis 450. Replace the bung and roll the drum back and forth for a few minutes to obtain a good mix. During this procedure, periodically stop rolling the drum and crack the bung to relieve pressure buildup.

NOTE

The GE Betz 8Q462 thermal stability additive (+100) can raise the conductivity level in JP-8 by 150 CU at ambient temperatures and as much as 300 CU at extreme temperatures. Fuels Management must consider this and monitor conductivity limits on receipts and when blending SDA if +100 is injected at the fillstands.

g. When SDA is blended into floating roof tanks, it can be introduced through various openings in the floating roof with a funnel and rubber hose, which extends under the surface of the fuel. Insure the openings are not roof water drains. In most cases, the roof seal may be pulled away from the perimeter of the tank and the additive poured into the fuel. This can be done at several places around the tank to hasten the mixing process. After additive is poured into the tank, circulate the tank contents if possible. If circulation is not practical, allow tank to stand until top middle and bottom CU readings are 125 or higher.

h. Cone roof tanks in general and those with floating pans in particular are the most difficult to blend. If tank ullage permits, the required additional additive can be introduced with new product. The additional additive may be added to delivery rail cars and tank trucks prior to transferring fuel to the bulk tank. If the bulk tanks are pipeline supplied, the supplying terminal can over-inject the product being delivered to the low tank to give an overall satisfactory value in the receiving tank. If the capability to circulate exists, additive may be aspirated into the circulating line upstream of the pump. Tank contents should be allowed to stand for at least 24 hours to allow additive mixing.

i. Some tanks have only a standpipe (gauge pipe) for an opening. When fuel in this type system has low CU readings do not put the additive into the gauge pipe. The best method is to pump the contents of the tank to another bulk tank where the required additional additive can be blended. Once this is done and the fuel has a satisfactory CU range, it can be returned to the system.

j. In smaller hydrant system tanks additive may be poured through the gauge hatch of the tanks to be blended. Product in the system may then be circulated between tanks until a satisfactory mix is obtained.

k. It is impossible to cover every situation on how additive should be blended into base stocks AF wide. When additive must be blended into base stocks, Base Fuels Personnel are encouraged to contact DET 3, WR-ALC/AFTH, for assistance in evaluating the various blending options.

A.5 LEAK DETECTION ADDITIVES.

a. Any chemical added to aircraft or ground fuels may effect engine performance, maintenance, or life span. The Air Force Research Laboratory, AFRL/PRTG at Wright Patterson AFB, OH is the approving authority for additives in jet fuel and the U.S. Army Tank Automotive Mobility Technical Center-Belvoir (AMSTA-RBF) is the approving authority for additives in ground fuels. Additives that have not been approved by these agencies will not be added to USAF fuels.

b. Chemical Leak Detention Compounds (LDCs) currently approved are listed in Table A-2.

c. Contracts let for the purpose of injecting chemicals into these fuels must be coordinated with Fuels Management Team (FMT) and include the following requirements:

(1) FMT must be present during inoculation. FMT will witness the inoculations and verify the contractor records the data pertinent to the injection of each tank. Use AFTO Form 149, Fuel Inoculation Record. For aboveground tanks, inject LDCs via a quick-disconnect fitting installed in system piping, where possible.

Table A-1. SDA Blending Quantities

Quantity to Be Doped	0.25 ppm	0.50 ppm	0.75 ppm	1.0 ppm
1,000 gal	10 ml	21 ml	31 ml	41 ml
2,000 gal	21 ml	41 ml	62 ml	82 ml
3,000 gal	31 ml	62 ml	92 ml	123 ml
4,000 gal	41 ml	82 ml	123 ml	164 ml
5,000 gal	51 ml	103 ml	154 ml	205 ml
10,000 gal	102 ml	205 ml	307 ml	409 ml
15,000 gal	154 ml	307 ml	461 ml	614 ml
20,000 gal	205 ml	409 ml	614 ml	818 ml
25,000 gal	256 ml	512 ml	767 ml	1,023 ml
50,000 gal	512 ml	1,023 ml	1,535 ml	2,046 ml
100,000 gal	1,023 ml	2,046 ml	3,069 ml	1.1 gal
500,000 gal	1.4 gal	2.7 gal	4.1 gal	5.4 gal
1,000,000 gal	2.7 gal	5.4 gal	8.1 gal	10.8 gal
1,000 bbl	430 ml	860 ml	1,289 ml	1,719 ml
2,000 bbl	859 ml	1,719 ml	2,578 ml	3,437 ml
3,000 bbl	1,289 ml	2,578 ml	1.1 gal	1.4 gal
4,000 bbl	1,719 ml	3,437 ml	1.4 gal	1.8 gal
5,000 bbl	2,148 ml	1.1 gal	1.7 gal	2.2 gal
10,000 bbl	1.1 gal	2.3 gal	3.4 gal	4.5 gal
25,000 bbl	2.8 gal	5.7 gal	8.5 gal	11.3 gal
50,000 bbl	5.7 gal	11.3 gal	17 gal	22.7 gal
80,000 bbl	9.1 gal	18.2 gal	27.2 gal	36.3 gal

NOTE

- Quantities of additive in the 4 columns are a mix of 1 part additive and 9 parts fuel.
- The quantity in the column header is the neat amount of SDA in the 9 parts of turbine fuel in that column.

(2) Fuel stored by using activities in tankage such as organizational, support, or power generating tanks is not the responsibility of the FMT. Tank Custodians Or their Designated Representative (TCODR) will provide the same oversight as prescribed for the FMT.

(3) All tank inoculations and calculations related to LDCs will be performed by contractor employees. The FMT/TCODR oversight person will provide shell capacity and inventory figures for all tanks.

(4) The contract Point Of Contact (POC) will notify FMT/TCODR at least 72 hours prior to desired inoculation date, to coordinate the work plan, insure FMT/TCODR escort is available and ensure there are no known circumstances to prevent inoculation on that date.

(5) The contractor will provide a completed and signed copy of the AFTO Form 149 to the POC and the FMT after inoculation and prior to leaving the base.

(6) FMT will retain completed AFTO Form 149, for all aviation fuel tanks. Retain, store, and dispose with the appropriate aviation stock fund records. Ensure inoculation rates are within the

limits specified in Table A-2. Contactor must provide amount injected by gallon quantity.

(7) The contractor will report tank failures and suspected leaks to the respective base LGSF and CEV via phone/fax (hardcopy to follow) within 24 hours. Contractor will also provide recommendation for follow-up action.

(8) Each MAJCOM/CEV that has bases under contact or subcontract for chemical leak detection services will provide the contractor a listing of each base Resource Control Center (RCC), 24-hour telephone number and mailing address. Listings will be provided by the MAJCOM/LGSF upon request. An updated copy of the Air Force Fuels Directory may be substituted in lieu of a base and RCC 24-hour listing.

(9) Contractor will provide POC, FMT, TCODR, and CEV with copies of the appropriate MSDS for each LDC used.

(10) Contractor will recover and properly dispose of unused chemicals, containers, or contaminated materials.

A.6 THERMAL STABILITY ADDITIVE.

WARNING

The GE Betz thermal stability additive is a surfactant and will disable the standard DoD and API 1581 3rd Edition filter separator coalescer elements.

a. JP-8 with a thermal stability additive is referred to as JP-8+100. The additive improves the thermal stability of JP-8 by approximately 100°F, from 325°F to approximately 425°F. GE Betz 8Q462 (Shell Aero 101 in Europe) is the brand of thermal stability additive approved for use in Air Force fuels. The +100 additive will be additized at authorized locations at 256 ppm (976 ml or 33 oz per 1,000 gallons). This additive must be injected downstream of the fillstand filter separator coalescer elements. Bases utilizing the +100 additive will treat additized fuel as a separate grade. MAJCOMs shall establish procedures to prevent the issue of +100 fuel to non +100 aircraft or the accidental commingling of +100 with non +100 fuel.

b. Only select Air Force aircraft are authorized to use fuel with the +100 additive. Non +100 aircraft (i.e., Navy/Marine Corps, contract carriers, foreign military, or commercial aircraft) will not be issued +100 fuel, except under emergency conditions. The aircraft pilot must justify the emergency on an AFTO Form 148 prior to aircraft servicing. Base Fuels Personnel will follow the form's distribution instructions within 24 hours of fuel issue.

WARNING

API 1581 3rd Edition and DoD coalescer elements must be replaced after contact with +100 additized fuel prior to being returned to aircraft service.

c. Defueled JP-8+100 must be strictly controlled.

(1) Defueled with absorption media element equipped refueling units is the preferred method. This fuel may be returned to a JP-8+100 program aircraft, used in Aerospace Ground Equipment (AGE), or used in an engine test cell facilities.

(2) If feasible, it may be drained into a bowser. This fuel may be used in AGE or in engine test cell facilities.

(3) Defueled into a nonprogram defuel unit, contact DET 3, WR-ALC/AFTH for guidance.

(4) As a last resort, the JP-8+100 may be blended into bulk fuel stocks provided the blend ratio does not exceed 1 part of JP-8+100 to 100 parts of JP-8. If the fuel passes through a filter separator prior to dilution, these elements must be replaced.

WARNING

The GE Betz thermal stability additive is a surfactant and will immediately disable the standard DoD and API 1581 3rd Edition filter separator coalescer elements. Refueling unit coalescer elements must be replaced with absorption media elements prior to conversion for use with the +100 additive.

d. The GE Betz +100 additive can raise the conductivity level in JP-8 by 150 CU at ambient temperature and as much as 300 CU at extreme temperatures. Quality control personnel will strictly monitor CU levels in JP-8+100.

e. Currently there is no approved base level test to determine the concentration of +100. QC will be maintained by monitoring the additive injection rate at the injector at least every 7 days. The presence, not concentration, can be determined by shaking a fuel sample. The surfactants in +100 will cause the fuel to foam.

f. To convert refueling units to non +100 status, the unit must be drained. No more than fifty gallons of fuel may collectively remain in piping, hoses, and filter separator. After filling, rotate 1,000 gallons through each hose. To convert units to +100, simply fill the unit with JP-8+100. Aircraft are considered off of +100 status after 2 consecutive refuels with at least 75% of the aircraft fuel load using non +100 fuel.

A.7 FIELD ADDITIVE INJECTION PROCEDURES.

a. General – follow these procedures when preparing and injecting FSII, CI/LI, and SDA into commercial turbine fuels. These procedures specifically address performing calibrations of the Hammonds Model 4T4A and Model 800IL injectors in field conditions.

(1) Ensure that the injector is positioned level with the ground (this will ensure the proper cooling of the injector bearings).

(2) Position additive supply tanks(s) above the injector pump(s).

(3) The most common cause of pump failure is an air leak on the suction hose. (Use Teflon tape on all fittings.)

(4) When an injector is placed into service for the first time, disconnect the supply hose on the suction side and allow the additive to push any air out of the line, then reattach the line to the injector. This will enhance the pump priming.

b. Understanding that 1 ppm equals 0.000128 fluid ounces per gallon enables you to convert ppm to ounces and allows you to determine the proper amount of additive required for a predetermined number of gallons of fuel. Assume you want to inject 30 ppm of SDA. To determine the amount of SDA that will be injected per 1 gallon of fuel multiply 30 ppm x 0.000128, which equals 0.00384 fluid ounces. In this exercise, assume the quantity of fuel to be additized is 3,504 gallons. Simply multiply 30 ppm x 0.000128 x 3,504 gallons, which equals 13.45536 fluid ounces. This means an injector, properly calibrated at 30 ppm, should inject 13.5 ounces of SDA into 3,504 gallons of fuel.

c. Procedures – to determine how much additive is being injected you will need to use a small tank as an additive supply tank. (A small tank is needed because the Hammonds Model 4T4A does not come equipped with calibration cylinders.) Normally, the injectors are deployed with 2 or more small six-gallon rectangular additive tanks. These tanks have a capacity of 6.23 gallons and are 6 inches deep. The tank depth equals 1 gallon per inch when the tank is level. Using a common wooden or metal ruler, you can easily measure the tank contents before and after injection to determine the amount of additive being injected. Since 1 inch equals 1 gallon or 128 fluid ounces, then 1/8 inch equals 16 oz when using these tanks. To use the six-gallon additive tank to calibrate the injector while it is in the inject mode, measure the tanks contents before and after with a ruler to determine the amount of additive injected into the specific quantity of fuel. As an example, let's say we are trying to achieve a 30 ppm injection rate (diluted SDA) and the difference between the before and after stick readings on the six-gallon additive tank is 1/2 inch, which equals 64 oz. The quantity of throughput was 20,000 gallons. Therefore, 30 ppm x 0.000128 x 20,000 gallons equals 76.8 ounces. As we already measured the tank and know that the injector injected 64 ounces, the pump stroke adjustment needs to be adjusted to a higher number (possibly 1 increment, from 10 to 11) to increase the injection ratio.

WARNING

Undiluted FSII is both combustible and toxic. It is harmful if inhaled or absorbed through the skin. It causes eye irritation. In laboratory animal studies, birth defects and adverse effects on pregnancy have been observed, and prolonged and repeated exposure has caused damage to male reproductive organs. Before handling, consult appropriate safety and occupational health authorities.

(1) FSII – the above referenced six-gallon tanks are useful when calibrating FSII injection rates. The Hammonds Model 4T4A injectors are equipped with injection/calibration valves that allow you to position the injector in the INJECT or CALIBRATE mode. When in the calibrate mode the injection fluid is channeled from the injector to the atmosphere where an operator can catch the additive in a container to verify the amount of fluid being pumped by the injector. For example: to perform initial injector calibrations, place the valve in the calibrate position and adjust the calibration dial so that the injector delivers 64 oz (½ gal) of FSII into a container during a 500

gallon throughput of fuel (by the meter). Under these conditions the injector is injecting against atmospheric pressure, not line pressure. Calibrating the injector at atmospheric pressure to obtain initial injection rates is a good start-up procedure, but to obtain true calibration you must calibrate the injector during normal injection operation against line pressure. So on the first actual use of the injector it will be necessary to conduct calibration adjustments while the injector is in the inject mode and operating against line pressure. To calibrate the injector against line pressure, set the injector in the injection mode and use a six-gallon additive tank as a supply tank for FSII. Using a ruler, the contents of the additive tank will be monitored and the injector calibration knob will be adjusted so that the injector delivers 1 gallon of FSII (equal to 1 inch of fluid in the six-gallon tank) to every one thousand gallons of fuel. After initial calibration against line pressure using the six-gallon tank, you can utilize the drum charts in Table A-5 to determine the volume of additive being injected. Your measurements should correlate with the B-2 Refractometer measurements.

(2) CI/LI/SDA – to inject CI/LI and SDA with the Hammonds Model 4T4A both additives must be diluted with fuel prior to injection. After dilution, the pump injector dial is normally set to 10 (the maximum low end of the stroke adjustment range).

(a) Dilute CI/LI with equal parts of turbine fuel and then inject the dilution at a rate of 30 ppm. This will provide a neat CI/LI injection rate of 15 ppm, which is mid-range of the quantity, recommended for injection in the CI/LI Qualified Products List (QPL-25017). While QPL 25017 sometimes recommends varying injection rates of CI/LI, depending on the type of CI/LI being injected, for field applications always calibrate injectors to deliver 15 ppm of neat CI/LI.

(b) Important – prior to injecting SDA you first must test the turbine fuel with a CU meter to assure the product doesn't already contain SDA. If the turbine fuel contains 25 CU or less you need to inject SDA.

(c) You must dilute neat SDA prior to injection. SDA must be diluted at a minimum of 1 part SDA to 19 parts of fuel.

1 Put 1 quart (32 oz) of neat SDA into a empty five-gallon jerry can.

2 Fill the jerry can with turbine fuel and mix thoroughly.

3 Transfer the diluted 1/19 SDA mixture to a six-gallon additive supply tank.

4 Set the injector stroke adjustment on 10. This will provide approximately 30 ppm injection.

(d) With the 1/19 SDA mixture, injection of 30 ppm will normally provide a 200 – 300 CU level. Typically, no more than 1.5 ppm of neat SDA should be injected in any dilution (1/19 dilution injection of 30 ppm equals approximately 1.5 ppm of neat SDA). If lower CU levels are desired it will be necessary to dilute the neat SDA more than 1/19 because injection can not be controlled with a pump stroke adjustment lower than 10. To dilute the neat SDA more than 1/19 put 1/2 quart (16 oz) of neat SDA in the jerry can before filling the jerry can with turbine fuel. Now you are prepared to inject approximately 50 ppm of the 0.5/19 mixture. Initially, start with the pump stoke on 15 and increase/decrease further until you achieve the desirable CU readings in the fuel.

(e) In summary a review of injection objectives and calculations follow:

1 FSII

Objective: 1000 ppm

1000 ppm x 0.000128 x quantity of fuel to be additized = fluid ounces of required FSII for injection. A reading on the B2 Refractometer of 0.10% is equal to 1000 ppm. In field conditions FSII resupply is complicated and FSII reserves can be maximized by targeting 800 ppm as an injection ratio. This will still equal a 0.08% FSII reading and will reduce consumption by 20%.

For start-up set both stroke adjustments on 40.

To achieve 0.10% by volume; 1000 ppm x 0.000128 = 0.128 ounces per gallon

To achieve 0.08% by volume; 800 ppm x 0.000128 = 0.102 ounces per gallon

2 CI/LI

Objective: 15 ppm neat CI/LI

Dilute with equal parts turbine fuel. Inject 30 ppm of 1/1 dilute 30 ppm x 0.000128 = 0.0038 ounces per gallon

25 ppm x 0.000128 = 0.0032 ounces per gallon

For start-up set both stroke adjustments on 10.

3 SDA

Objective: 1.5 ppm neat SDA dilute with minimum of 19 parts fuel to 1 part neat SDA. One quart (32 oz) of neat SDA in five-gallon jerry can filled with turbine fuel equals 1/19 dilution.

Inject 30 ppm of 1/19 dilution to obtain a 200 – 300 CU.

For start-up set injector stroke adjustment on 10.

4 JP-8+100 – GE Betz 8Q462 (Shell Aero 101) (distributed as Shell Aero 101 in Europe).

Objective: 256 ppm neat 8Q462 (Shell Aero 101)

256 ppm x 0.000128 = 0.032768 ounces per gallon

256 ppm x 0.000128 x 1000 gallons = 32.768 ounces per thousand gallons.

The typical injector used for the injection of JP-8+100 is the Hammonds Model 800IL.

This injector is equipped with a 40 ounce calibration cylinder and one 1L pump.

For start-up set stroke adjustment on 20.

To avoid disarming filter separator coalescer elements, injection is normally performed downstream of the fillstand filter separator vessel. Refuelers must be retrofitted with absorption media elements to handle JP-8+100.

d. Methods of Blending – the 2 basic methods for putting additives into fuel are hand doping and use of a proportional injector. The preferred method is proportional injection using a fuel driven injector as described in the previous paragraphs of this appendix. This type of injector injects additives proportionately at various flow rates. Hand doping additives at various points in the system can be accomplished by several techniques, some of which are as follows:

(1) Blending additives into bulk airfield tanks can be done by pouring the required quantity of additive into the tank heel followed by receipt. The required quantity of additive may also be added to delivery tank trucks just prior to off-loading into bulk tanks.

(2) Blending into refueling units can be performed by introducing the required amount through the top hatch using a funnel and a length of hose with one end submerged below the surface of the fuel. This is best done by pouring the additive into the refueler filled to not more than one-third of its capacity and then filling the unit. Wait approximately 10 minutes and then circulate fuel for at least 3 minutes before servicing to aircraft. If additives are put into a full refueler, circulate at least 150% of the refueler capacity prior to issue. In all cases where hand doping is performed, additive should be first diluted with the fuel. The greater the dilution, the easier it is for the additive to be mixed properly. Fuel additives shall not be mixed together in neat form, except as explained in the WARNING preceding Paragraph A.1.

e. Personnel Protective Equipment – in an outdoor environment, as a minimum personnel should wear protective gloves and eye protection when mixing and pouring neat additives.

Table A-2. Approved Volatile Chemical Tracer Leak Detection Additives

Company	Chemical Additive Name	Maximum (Total) Concentration of Additive Allowed (ppm)	Approved by WP/POSF for Aviation Fuels	Approved by AMSTA-RBF for Ground Fuels
Tracer Research Corp. 3755 North Business Center Dr. Tuscon, AZ 85705	Tracer A	10 ppm	YES	YES
Tracer Research Corp. 3755 North Business Center Dr. Tuscon, AZ 85705	Tracer E	10 ppm	NO	YES
Tracer Research Corp. 3755 North Business Center Dr. Tuscon, AZ 85705	Tracer N	10 ppm	NO	YES
Tracer Research Corp. 3755 North Business Center Dr. Tuscon, AZ 85705	Tracer R	10 ppm	YES	YES
Tracer Research Corp. 3755 North Business Center Dr. Tuscon, AZ 85705	Tracer W	10 ppm	NO	YES

Table A-3. FSII — Portable Multi-Additive Injector

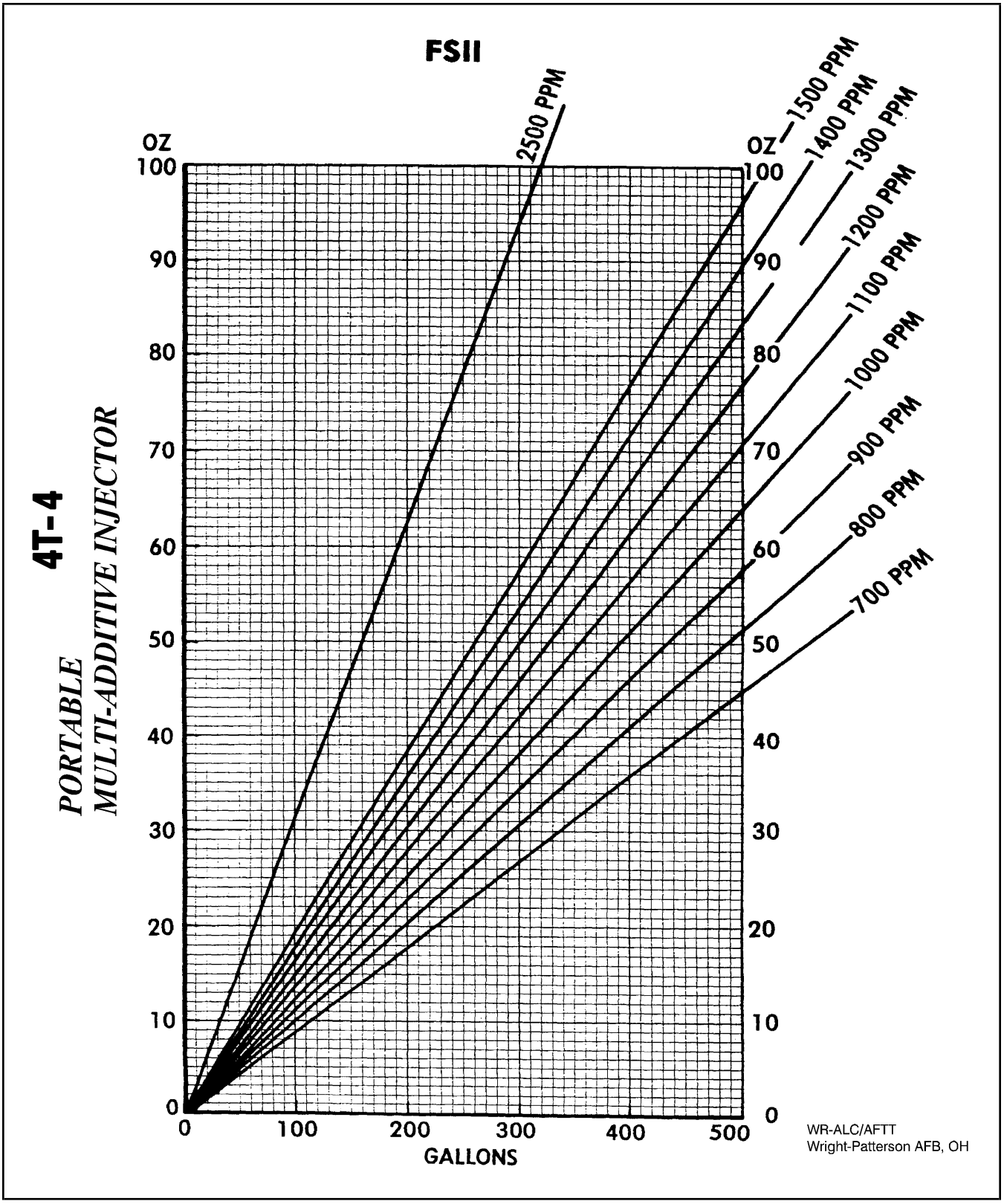


Table A-4. CI/LI & SDA — Portable Multi-Additive Injector

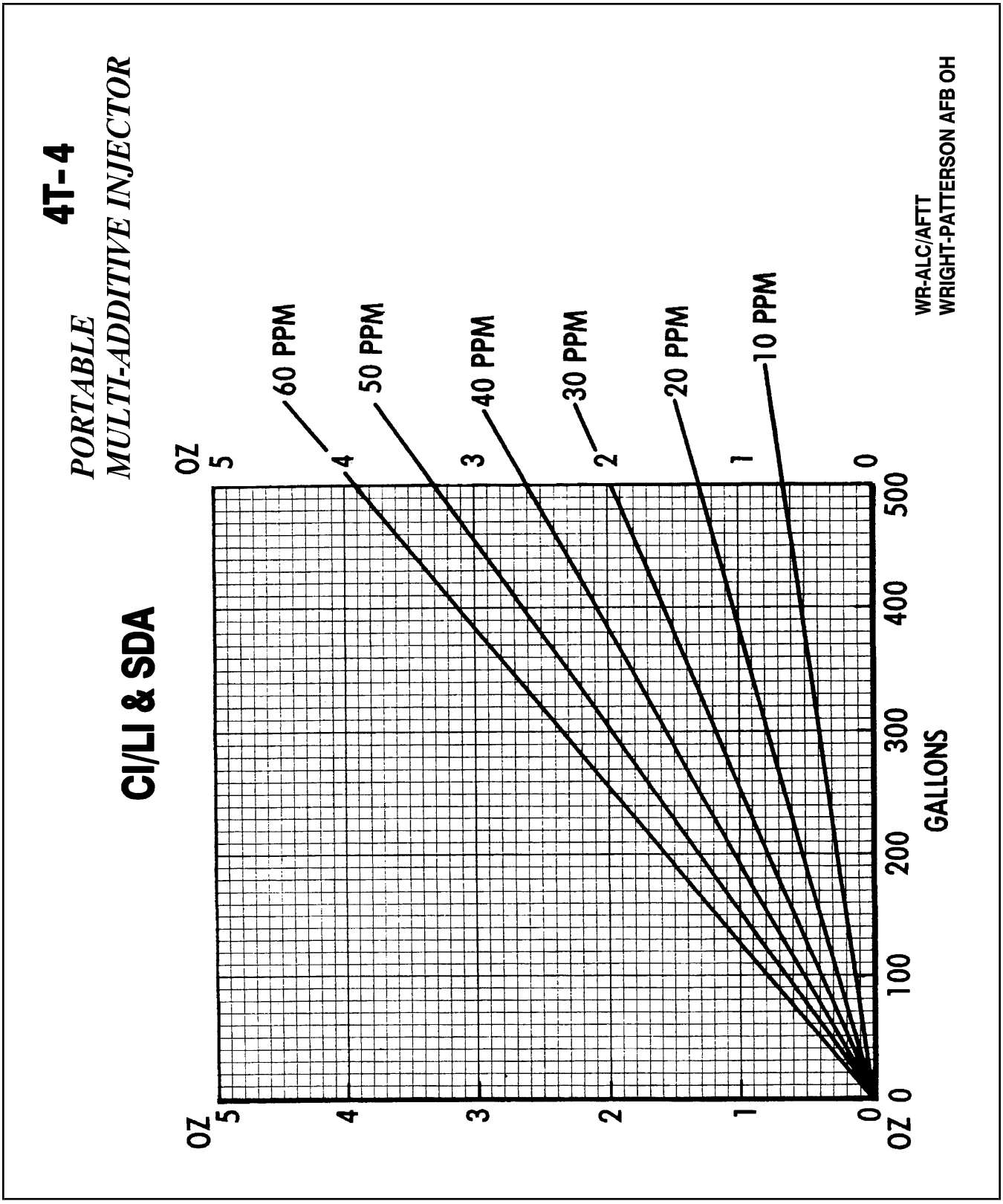


Table A-5. Gauging 55-gallon Drums (Approximate)

GAUGING 55 - GALLON DRUMS (APPROXIMATE)

PROCEDURE

Dip an ordinary yardstick into the drum to get a wet inch reading. Apply this number to the horizontal axis of these charts and get your value in gallons from the vertical axis.

The values on these charts were obtained at 60°F. Correct for measurements at higher or lower temperatures by a factor of about 0.6 percent increase or decrease in volume per degree.

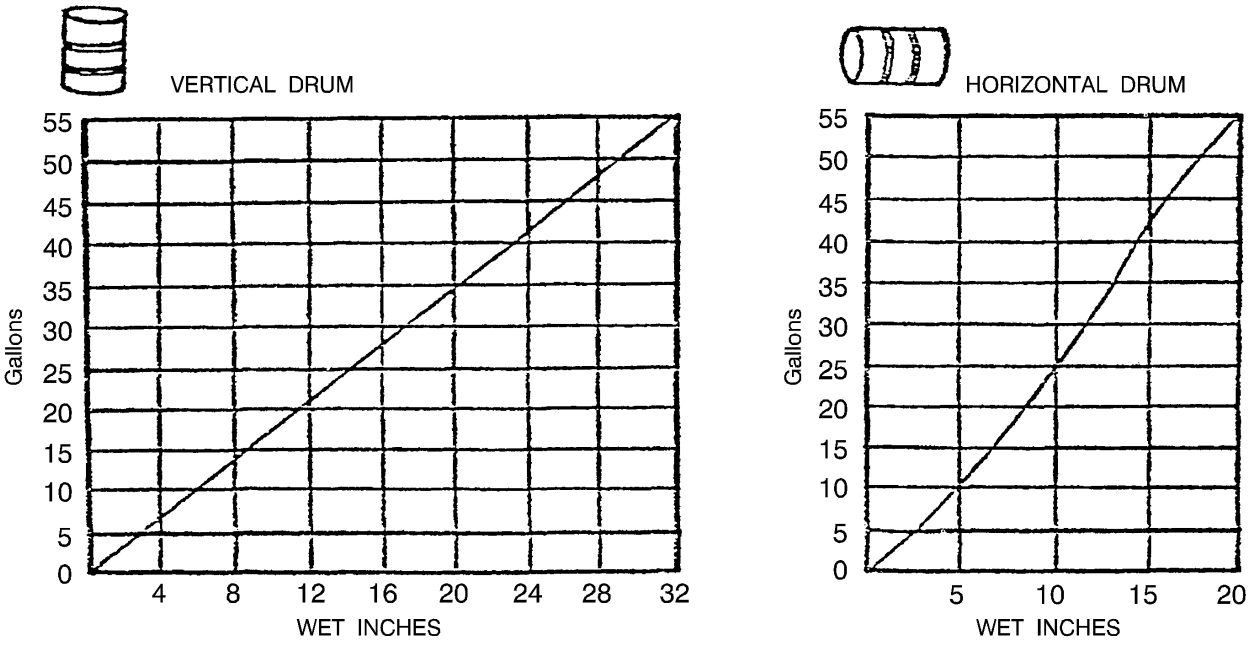


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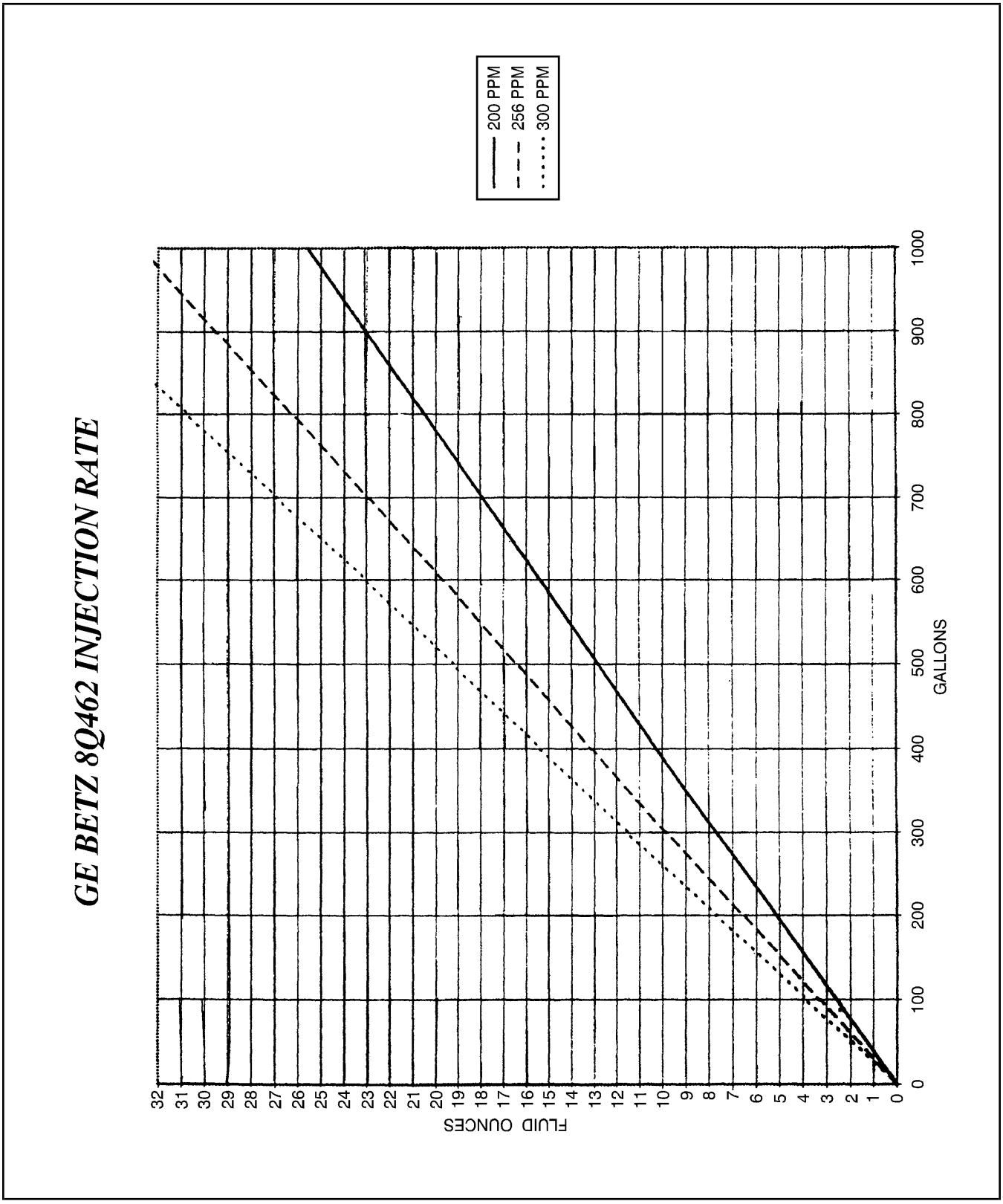
Table A-6. GE Betz 8Q462 Injection Rate



APPENDIX B
EQUIPMENT FOR LABORATORY TESTING

B.1 The equipment and material listed in this appendix are for convenience and easy reference. Therefore, use of an item or material listed should not be construed as mandatory except when specified by the particular ASTM or test procedure. The ASTM 5F thermometer listed under conductivity, has a temperature range suitable for normal worldwide use, i.e., –36°F (–38°C) – 120°F (49°C). However, ASTM D 2624 Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels Containing a Static Dissipator, only requires a thermometer having a suitable range for measuring fuel temperature in the field. Therefore, the ASTM 5F thermometer is not mandatory for CU testing. Another example is the MICRO (concentrate) Liquid Laboratory Cleaner. The use of MICRO cleaner is not mandatory. Any generic glassware cleaner stocked in medical supply should be satisfactory for fuel laboratory glassware.

Table B-1. Equipment for Laboratory Testing

Item		NSN
Container, Fuel Sample, 1 gal UN1A1		8110-01-371-8315
Jerry Can, 5 U.S. gal (lusterless sand) UN – Certified for (forest green) Air Shipment (plastic)		7240-01-337-5268 7240-01-337-5269
Kit Sampling for Aviation Fuels		8115-00-719-4111
Overpack Sampling Kit		8110-00-254-5715
SAMPLING EQUIPMENT		
Weighted Bottle		Procure Locally Gammons Technical Products Manasquan, NJ Model GTP-9021 or Koehler Instrument Company Bohemia, NY Model K27601-10000
Light Oil Bottle, ¾ inch opening		Procure Locally
Sampler, Bacon Bomb		6695-00-946-3602
Thief, Oil Drum		6695-00-512-1816
SOLIDS BY COLOR AND PARTICLE ASSESSMENT METHOD		
Monitor Kit Fuel Sampling, GTP-172H		6630-01-230-2652
Sampling Hose, GTP-5808 (order for above)		4720-01-230-8529
Single Filter Monitor, Millipore		6640-00-445-3662
Steel, Stainless w/3-Way Valve (for millipore in-line sampler)		6630-00-488-6622
Aviation Turbine Fuel Contamination Standards		6640-00-326-7684
Syringe, Metal w/2-Way Valve		6640-00-070-4874
Plastic Solvent Dispenser Petroleum Ether		6640-00-299-8493 6810-00-584-3079
Coupler, P/N AVEAC4-4M		4730-00-978-8760 (inch nipple)
Coupler, P/N AVEAC4-2M		4730-00-943-8716 (1/8 inch nipple)
Plug, P/N AMPE-4		5340-00-706-1036

Table B-1. Equipment for Laboratory Testing - Continued

Item		NSN
Jet Test QD Coupler, GTP-235 ¼ inch (fits D-1 nozzles)		4730-01-135-7461
Sampling Valve Assembly, GTP 423		4820-01-170-7087
MATCH-WEIGHT MONITOR METHOD		
Matched-Weight Monitors		6630-00-764-5761
Monitor Kit Fuel Sampling, GTP-172H		6630-01-230-2652
Sampling Hose, GTP-5808 (order for above)		4720-01-230-8529
Filtering Flask, 100-ml		6640-00-424-9000
Vacuum Pump, extractor pump for removing water from underground tanks		4310-00-821-8521
Vacuum Pump, for laboratory filtration and testing		4310-00-566-8078
Solvent Filtering Dispenser		6640-00-688-7882
Filter Discs, 0.45 micron 25 mm, White Plain, P/N HAWP 025 00		Procure Locally Millipore Corp., Bedford, MA 01730
Forceps		Procure Locally
Thermal Drying Oven		4430-01-087-6776 YB
Rubber Stopper, One-Hole No. 8, P/N 14-135M		Procure Locally Fisher Scientific Co. 7722 Fentn St. Silver Spring, MD 20910
Analytical Balance Digital, P/N AE-160		6670-01-104-1773
Analytical Weights [1]		6670-00-401-8800
Microscope, Bausch and Lomb, ST-22		6650-00-072-3102 Procure Locally
Dishes, Culture Petri	Top Bottom	6640-00-422-1000 6640-00-422-2025 Procure Locally
Petroleum Ether		6810-00-584-3079
Isopropyl Alcohol (2-propanol)		6810-00-855-6160
BOTTLE METHOD		
Test Stand, P/N GTP-8197		Procure Locally Gammon Technical Products
Microanalysis Filter Holder Assembly, P/N TL-8198		Procure Locally Gammon Technical Products
Dispensing Plug for 1-gallon Sample Can, P/N TL-8369		Procure Locally Gammon Technical Products
Flask Connect Hose, P/N TL-8372		Procure Locally Gammon Technical Products
Vacuum Attachment, P/N TL-8373		Procure Locally Gammon Technical Products
Filter Discs, 0.8 micron 47 mm, White Plain		6640-00-967-0501

Table B-1. Equipment for Laboratory Testing - Continued

Item		NSN
Filter Particulate, 1.2 micron, 47 mm, GRID (for diesel fuel cloud point filtration)		6640-01-020-8783
Filter Particulate, 0.8 micron, 47 mm, nylon (for particulate filtration on diesel fuels)		Procure Locally
Cylinder, Graduated, 1,000-ml		6640-00-420-3000
Desiccator Plate		6640-00-551-9349
Desiccant, 5-lb can		6850-00-290-0042
Desiccator		6640-00-527-7342
Dishes, Culture Petri	Top Bottom	6640-00-422-1000 6640-00-422-2025 Procure Locally
Metal Container, 1-gallon		8110-00-128-6819
Soap, Laboratory Glassware		Procure Locally
Rubber Stopper, One-Hole No. 12, P/N 14-1355R		Procure Locally Fisher Scientific Co.
Paper Flow Reducer Ring, P/N XX1004710		Procure from Millipore Corp. Bedford, MA 01730
Filtering Flask, 4,000-ml		6640-00-522-1889
Vacuum Gauge Standard Bottom Connected, Range 0 – 30 in Hg		Procure Locally
Solvent Filtering Dispenser [2]		6640-00-688-7882
Forceps [2]		Procure Locally
Thermal Drying Oven [2]		4430-01-087-6776 YB
Analytical Balance Electronic [2]		6670-01-104-1773
PVC Coated Safety Bottle, 1-gallon		Procure Locally
Analytical Weights [2]		6640-00-527-7359
Microscope, Bausch and Lomb, St-22 [2]		6650-00-072-3102 Procure Locally
Microscope Lamp [2]		6650-00-071-3101
Thermometer		6630-00-247-2972
Spring Clamp, P/N XX10047303		Procure from Millipore Corp. Bedford, MA 01730
FREE WATER METHOD		
Aqua-Glo Water Detector Kit, Gammon, GTP-323		6640-01-138-2563
Kit, AEL Water Detector		6640-00-070-2627
Battery Case		6135-00-181-2452
Holder, Detector Pad, Stainless Steel, GTP-3850		6640-01-406-0148
Syringe, Metal w/2-Way Valve		6640-00-070-4874
Detector Pad, AEL (37 mm)		6640-00-105-4386
Water Detector Pads (25 mm) Gammon		6640-00-235-3820
Ultraviolet Lamp		6640-00-683-0723
Ultraviolet Light Starter		6250-00-299-2884

Table B-1. Equipment for Laboratory Testing - Continued

Item		NSN
Vitron O-Ring, 1 – 239 feet ID and 0.070		5330-00-166-1025
Printed Standard, AEL		6640-00-999-2784
Polyethylene Bottle, 850-ml, P/N XX6403710		Procure from Millipore Corp.
NOTE The printed standard located in the base of the box will be replaced and dated annually.		
FSII B/2 REFRACTOMETER		
Refractometer, Test Kit Fuel		6630-01-165-7133
Cylinder, Graduated – 250-ml Glass		6640-00-290-6543
Cylinder, Graduated – 250-ml Plastic		6640-00-061-2794
Pipette, 2-ml Plastic		6640-01-046-7155
Separatory Funnel, 250-ml Glass		6640-00-058-4469
Refractometer, P/N HB-R-1		6650-01-229-5751
DIESEL CLOUD POINT TEST		
Cloud Point Analyzer, Model CPA-T30		Procure Locally Phase Technology Tel: (604) 241-9568 www.phase-technology.com
Test Cylinder – Cloud and Pour, Graduated, P/N 52924-771		6640-01-238-0358 VWR Sargent Welch P.O. Box 5229, Buffalo Grove, IL, 60089-5229 Tel: (800) 727-4368 www.wheatonsci.com
Thermometer ASTM 5F Cloud and Pour – 36° – 120°F, P/N S-80575		6685-00-247-3737
CONDUCTIVITY		
Digital Conductivity Meter, Model 1152		6630-01-115-2398 (prime item)
Energizer Photo — Electronic Batteries (6.0V) (Model 1152)		6135-01-115-2867 (P/N A-544)
Silver Oxide Batteries, I.S.V. (Model 1151A)		6135-00-853-8670
Thermometer ASTM 5F		6685-00-247-3737
Stadis 450 DuPont		6850-01-097-2060 (1 gallon) 6850-01-099-4015 (5 gallons)
FLASH POINT JP-8, JP-5, AND DIESEL		
Tester Flash Point, Closed Cup, FSCM 81349		6630-00-530-0987

Table B-1. Equipment for Laboratory Testing - Continued

Item		NSN
Propane Cylinder (required with Seta Flash and Pensky-Martens Methods)		6830-00-584-3041
Thermometer ASTM 9F for Flash Tester (20° – 230°F) (for Pensky-Martens)		6685-00-242-2183
Aneroid Barometer		6685-01-325-6293
Barometric, Conversion Scale Conversion Scale: Millibar/mm Hg / in./Hg		7640-01-329-5081 P/N S4519-25
FIBER DETECTION		
Bottle, 1-quart		8125-00-378-9994
Light, Desk Lamp		6230-00-643-2076
100-watt Bulb		Procure Locally
Aluminum Foil		Procure Locally
Poly-Seal Bottle Caps		Procure Locally
VISUAL INSPECTION		
Bottle, 1-quart Clear Glass		8125-00-378-9994
Jars, Sample Large Mouth, 1-quart		8125-00-297-1728
Food Coloring		8950-00-616-4513
HEAVY HYDROCARBONS IN AVGAS		
Test Tubes, 10 ml, 14 mm x 102 mm		6640-00-360-0046
Beaker, 50 ml		6640-00-403-1500
Ruler, 12-inch		7510-00-161-6215
Whatman No. 1, Chromatographic Paper		Fisher Scientific, FSCM 80011, P/N 05716-5A, Houston, TX 77099
Holder		—
Dye, Fuel Soluble Red		6820-00-559-3248
API GRAVITY HYDROMETER		
Two Hydrometers are required to cover the API gravity range for: MOGAS/AVGAS Range 49° – 71°		 6630-00-245-8374, Range 59° – 71° 6630-00-245-8377, Range 49° – 61°
JP-5/8 Range 29° – 51°		6630-00-245-8376, Range 39° – 51° 6630-00-242-9258, Range 29° – 41°
FUEL DENSITY LB/GL		
Hydrometer Graduate MA-1		6630-00-527-6149
API Gravity Calculator, P/N GTP-3012		Procure Locally Gammon Technical Products
Hydrometer Centering Device, P/N GTP-8401		Procure Locally Gammon Technical Products

Table B-1. Equipment for Laboratory Testing - Continued

Item		NSN
MISCELLANEOUS		
Distilled Water, 5 gallons		6810-00-107-1510
Reverse Osmosis Water Demineralizer (30 gallons per day) (optional)		Procure Locally Culligan Inc.
Detergent General Purpose		7930-00-279-7089
Calcium Chloride 80-lb		6810-00-422-2169
Sodium Chloride [3] (table salt) (80-lb bag rock salt)		6810-00-227-0437
Solid Carbon Dioxide (dry ice)		Procure Locally
Underground Tank Water Extraction Pump		4310-00-012-1603

[1] Laboratories with Class S weights may submit these to base PMEL for calibration to Class P tolerances.
[2] These items are duplications of the equipment used in the color and particle assessment method and are listed for information only.
[3] Sodium chloride can be used as a substitute for calcium chloride.

APPENDIX C
TEST PROCEDURES

C.1 TEST PROCEDURES.

Table C-1. Test Procedures

Test Procedure	ASTM Method
DL-2 Cloud Point	D 2500
Conductivity Test	D 2624
Color and Particle Assessment Method	D 2276
Matched-Weight Monitor Method	D 2276
Filtration Time – JP-5	MIL-DTL-5624
Filtration Time – JP-8	MIL-DTL-83133
Matched-Weight	D 2276
Particulate Matter (Diesel Fuels)	D 6217
FSII Refractometer	D 5006
Solids/Filtration	D 5452
API Gravity Determination	D 1298
Heavy Hydrocarbons	WRDCL/POSF
Free Water AEL	U.S. Naval Aeronautical Engineering Lab
Free Water Aqua-Glo	D 3240
Fibers Test	MIL-PRF-52308/STANAG 3967
Flash Point TAG (Closed Cup)	D 56
Flash and Fire Points Cleveland (Open Cup)	D 92
Flash Point Pensky-Martens (Closed Cup)	D 93
Flash Point Setaflash (Closed Cup)	D 3828
Manual of Petroleum Measurement Standards	Chapter 7 API

APPENDIX D
AIRCRAFT SUMP SAMPLING PROCEDURES

D.1 SAMPLING EQUIPMENT REQUIRED.

a. Clear one-quart sample bottles.

b. Aircraft sump sampler.

c. Filtered dry cleaning solvent or a high-flash hydrocarbon fuel.

d. One gallon cans (for waste fuel).

NOTE

Clear quart sample jars and filtered solvent or fuel will be obtained from the Base Fuels Quality Control Laboratory.

D.2 PROCEDURES.

a. Sample jars will be cleaned IAW this T.O.

b. Clean exterior of aircraft jiffy or siphon drain with a solvent wetted cloth.

c. Drain 1 gallon of product from the sump and discard. This is to be accomplished by draining approximately 1/3 gallon, stop for 5 seconds, drain another 1/3 gallon, stop for 5 seconds, and finally drain the remaining 1/3 gallon.

d. Clean interior and exterior of aircraft sump sampler with filtered solvent.

e. Using a clean quart bottle, drain 1 quart of product from sump. Note appearance of sample. If the sample contains water or solids exceeding the following criteria, the sample will be discarded:

(1) Water – more than covers half the bottom of the bottle or if product is cloudy or hazy which denotes entrained water.

(2) Solids – more than 20 particles.

f. If excessive water or solids are noted, an additional gallon will be drained from the sump and discarded.

g. If the sample does not contain solids or water exceeding the above limits, the sample will be analyzed in the Base Fuels Laboratory for solids content.

D.3 BASE FUELS LABORATORY ANALYSIS.

a. Solids content will be determined by the bottle method as detailed in this T.O.

b. If the sample contains visual free water, the membrane filter will be washed with 50 ml of distilled or demineralized water after the final petroleum ether rinse.

c. Solids will be reported in milligrams per quart (mg/qt).

D.4 CONTAMINATION LIMITS.

The guidance in this T.O. specifies that contamination is considered excessive if the solids content is more than 4.0 mg and the appearance of the membrane filter, when compared to the particle assessment guide, is greater than G. Both weight and quantity of solids on the particle assessment guide must exceed the limits for the sample to fail. Stain or background color on the filter will not be considered. A one-quart recheck sample will be taken to verify results if contamination exceeds limits.

D.5 RECOMMENDED ACTIONS REQUIRED WHEN CONTAMINATION EXCEEDS LIMITS.

a. Defuel aircraft.

b. Inspect airframe and engine filters and clean or replace as necessary.

c. Refuel.

d. Sample aircraft sumps IAW procedures in Paragraph D.2.

e. Results must be within limits before permitting flight.

f. Failure of samples will require entry and cleaning of aircraft tanks.

D.6 GENERAL.

a. Samples taken from locations other than the sumps of aircraft tanks will not be used to determine cleanliness levels within the aircraft.

b. If excessive free or entrained water is still present in the product after performing the draining and sampling procedures in Paragraph D.2, the aircraft will continue to be drained until product is free of water or until it is evident that complete defueling is necessary. The estimated amount of water drained will be recorded.

c. Microscopic analysis of the solids can provide information as to contamination sources and is therefore recommended as a procedure to follow when limits are exceeded.